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CONTENTS

EDITORIAL:
An Emanation from Sodium . . . 979
Electricity as an Agent in Conserving Natural Resources . . . 980
Plans for Electric Railway Development in Bavaria . . . 981
The Institute Convention . . . 981
General Electric Company's Engineering Convention . . . 982
National Electrical Contractors' Association . . . 982
Meeting of the Contract and Inspection Department of the New York Edison Company . . . 982
Westinghouse Electric Statement . . . 982
To Investigate Telegraph Company's Operations . . . 982
Engineering of the Mechanical Equipment of a Large Store Building, by Percival R. Moses . . . 983
Annual Meeting of the Electric Properties Company . . . 986
Financial Reports of Electric Companies . . . 986
BOOK REVIEWS . . . 987
Electrical Porcelains . . . 987
Notes on the Electrical Engineering Department, Massachusetts Institute of Technology . . . 988
Annual Meeting of the National Electrical Trades Association . . . 988
Inspection of Tunnels of the Niagara Falls Power Company . . . 988
Railroads and Wood Preservation . . . 988
The New Ganz Three-Phase Locomotive, by C. L. Durand . . . 989
Merchants' Rate from the Territory of the Central Passenger Association . . . 992
Switchgear-Control Apparatus and Relays for Alternating-Current Circuits, by Charles C. Garrard . . . 993
Reunion of Thomson-Houston Employés . . . 996
Public Service Commission Bill Killed . . . 996
Power Development in Small Stations, by Charles Robbins and J. R. Bibbins . . . 997
Railroad Electrification . . . 999
Chinese Telegraph Lines . . . 999
Civil Service Examination for Electrical Engineer and Mechanical Draftsman . . . 999
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 1000
INDUSTRIAL SECTION:
Allis-Chalmers Air-Compressor at Pettibone-Mulliken Company's Plant, Chicago . . . 1002
A New Testing Wattmeter for Direct-Current Circuits . . . 1002
Sprague Octagon Box No. 6250 . . . 1003
Allis-Chalmers Mining Machinery for the Benito Juarez Mines Company . . . 1003
A New Removable Rolled-Rim Gear . . . 1003
The Brilliant Electric Company "Tungstoliers" . . . 1004
The Armor-Plate Vaults of the Carnegie Safe Deposit Company . . . 1004
Printing Attachment for Power Wattmeters . . . 1005
A New Nernst Lamp Holder . . . 1005

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AN EMANATION FROM SODIUM.

As is nearly always the case, the discovery of an unknown property of some form of matter leads to the further discovery of a similar property possessed by other, and possibly more familiar, materials. The first discovery is most frequently accidental, and the effect is noticed either because it is more pronounced under the conditions of the discovery, or, more generally, because of some unexpected action resulting from the conditions of the particular experiment which leads to its being noticed. This has been the case of the interesting and important class of phenomena classed as radioactive. First noticed accidentally in connection with uranium, it has now been shown to be a not unusual property, although the elements related to uranium possess it to the highest degree.

As a result of the study of radioactive phenomena, Rutherford separated and collected what seemed to be a volatile vapor also having radioactive properties, and which must either be a product of the disintegration of radium or else be a gas occluded by the material in its previous condition and liberated under the conditions of the experiment. Experimental evidence points to the first explanation as the more probable one.

Now it has been shown that other materials besides those which are put in the radioactive group seem to possess this property of giving off volatile vapors or emanations. It has been observed in connection with phosphorous, and in *Nature* (London) for May 28, Mr. E. S. Phillips says that he has observed a similar action with metallic sodium. When this metal is cut so as to expose a fresh surface, it possesses the property of discharging a negatively charged body. This action can be prevented in a number of ways, such as by blowing a slow current of air against the sodium so that the effect appears to be due to a positively charged vapor. Whether this vapor result from a disintegrating of sodium or of an unrecognized impurity in the metal, or whether it be merely occluded vapor, has not been shown, but as different portions of the sodium seem to possess the property to different degrees, the explanation that it may be due to an impurity seems the more plausible.

Such discoveries are of great interest and importance because of the probable bearing they will have on the science of the future. This particular branch of physics (or is it chemistry?) seems to be in about the same stage as was the science of electricity in Gilbert's time, when the wonderful and unexplainable behavior of certain materials, when rubbed or excited in various ways, was the subject of much learned speculation and theorizing. Since then the minute forces which he so patiently investigated have taken places among the most important agents

of man, and it may, perhaps, be that these radioactive forces and emanations will, before long, be as well-known and easily controlled as electricity is now. The energy involved by the disintegration of an element is incomparably greater than that evolved in any chemical reaction between atoms of which we have knowledge, and may it not be that before we have completely exhausted our fuel supplies and utilized all the water power available, we shall have found means for bringing about and controlling the disintegration of the elements, and of utilizing the energy thus liberated for all purposes? Such an outcome would solve many problems which we now see dimly obstructing the path of progress of future generations.

ELECTRICITY AS AN AGENT IN CONSERVING NATURAL RESOURCES.

In a paper prepared for the meeting of the governors of the different states at Washington last month, by H. St. Clair Putnam, some striking figures are given showing the value and importance of the water powers of the country. Mr. Putnam very aptly says that the present time is the age of power. He might have gone a little further in this direction and pointed out why it is that the use of electric power has spread so rapidly. Our consumption of fuel is said to double every ten years, while the use of electric power doubles every five years, and if this rate of increase be held, more than half the power used for driving machinery will be electrical in twenty years. The reason for this is the ease with which electric energy, manufactured at one point, is delivered for use at another. In fact, the past fifteen or twenty years have seen an entire new industry established—that of the manufacture and sale of energy, an industry made possible on any important scale by virtue of the ease with which it can be bought and sold.

Before the introduction of the electric motor, if a manufacturer wished to drive a machine, he had to put in a steam plant and attach an engine to the machine, either directly or by means of belts and line-shafts. These methods, while efficient for short distances and under favorable conditions, were not suitable for transmitting power over more than a few hundred feet; hence every factory had its own boilers and engines, and in large factories it was necessary to have two or three prime movers distributed at favorable points. The electric motor, however, made it possible not only to do away with all the intermediate shafts and belts, but rendered each machine, or group of machines, driven by a single motor, independent of its neighbors, and, what is equally important, made it not only possible to bring together all the small power plants into one large economical system, but also, if the manufacturer so desired, he need not himself manufacture his power, but can purchase it, generally at less cost than he can make it himself, from a large company which makes a business of selling energy and nothing else.

It is this feature, the ease with which electric power is produced at one point to be utilized at each machine in the most suitable manner, that promises to be an important factor in conserving our fuel supplies. Water powers are to-day valuable wherever situated; they can be utilized without imposing a serious handicap upon the mill, due to an unfavorable location, as there may be a distance of a hundred miles or more between the mill and the waterfall. For this reason waterfalls to-day have taken on a new importance. We no longer see in them magnificent but useless examples of nature's lavish waste of energy. They are recognized as valuable assets which will take the place of fuel, and from which may come the power to drive all the industries of the country.

With this idea it is interesting to see what our water powers are worth. Conservative estimates made by the Geological Survey, at Washington, put this at 30,000,000 horse-power, and this is merely power available to-day. With proper reservoirs for controlling the flow, the available power would probably be five times as great. But even the smaller figure is equivalent to all the power apparatus installed in the country, and when it is remembered that this apparatus is probably not used more than one-quarter or one-fifth of the time, while the 30,000,000 horse-power of the waterfalls is available day and night, it would seem that even without storage we have already power sufficient to drive three or four times as much machinery as is now in use. The power is there, but can only be utilized through electrical transmission, since the greater number of the power sites are naturally in locations not well adapted for operating mills, hence it is the development of electrical transmission which offers a solution of conserving the fuel supply.

Looked at in another way, if this 30,000,000 hydraulic horse-power be used continuously, it would represent the consumption of about 200,000,000 tons of coal yearly in the best type of steam plant. This is about half as much again as the total amount of coal produced in the country, and at an average price of $3 per ton, it is equivalent to an expenditure of $2,000,000,000 a year for fuel alone in plants of the average type.

These are magnificent figures, yet it should be borne in mind that at the present rate of increase of the use of power it would not be many years before we had utilized all the most available powers, and we should, therefore, take steps toward increasing and preserving these. Fortunately, this problem goes hand in hand with improving the rivers for navigation purposes, with the preservation of forests, and the protection of arable lands. By proper methods of forestry and the construction of storage reservoirs, we not only protect what we have, but we will actually increase the available power.

Statistics show that electric power was used in industries in 1905 to the extent of about twelve per cent of the total power. In 1900 it represented less than five per cent of the total. Steam power, on the other hand, is not increasing at anything like the same rate. In 1905 it represented a little less than seventy-four per cent of the total power used in manufactures. If these rates of increase are maintained, by 1930 more than half of the factories of the country will be driven electrically. It is not unlikely that the rate of increase in electrical application will itself increase. So many other advantages accompany the intro-

duction of the electric motor, besides what is in one sense the more important one—that of utilizing water power instead of coal—that in many industries the electric motor will be introduced even though the actual cost for power may thereby be considerably increased; and, on the other hand, the steadily increasing cost of fuel will drive more and more industries to districts where cheap electric power is available.

Another way of indicating the value of the water powers of the country is to estimate the value of the products and the wages resulting from their utilization. From the census of 1905 it is found that for each horse-power installed, product having the value of $1,152 was manufactured during the year, and wages amounting to $248 were paid. In the railroad industries the gross receipts were $555 and the yearly wages $224 for each horse-power employed. Assuming the available 30,000,000 horse-power of the streams to be fully developed, and applying the same ratio of wages to power, it would seem that the increase in wages due to this development would be about $15,000,000,000 a year. This represents a return, not to the capitalists, but to the workmen themselves.

These few figures are sufficient to emphasize very strikingly the value to the country, as a whole, of the power resources and the importance of utilizing electrical methods by which alone they are made generally available.

PLANS FOR ELECTRIC RAILWAY DEVELOPMENT IN BAVARIA.

The introduction of the electric motor for railway purposes seems to be going ahead in Europe where, for various reasons, important economies in operation are anticipated from the change, usually the principal one being the high price of fuel and the existence of available water power. In the ELECTRICAL REVIEW for January 4 the work which is being done in Sweden was reviewed briefly. The government of the railway department there has been investigating the advisability of electrification, and has been conducting some rather elaborate tests, the engineer of the department having decided upon the single-phase system as the most promising. Again, in the issue of April 18, the proposed electrification of Austrian railways was reviewed. Here the matter has not progressed so far, as there has been no decision in favor of any one system for general adoption, although the three-phase system has been decided upon for the Arlberg tunnel, which will be the first section to abandon the steam locomotive.

Now a third European state has taken up the matter carefully, and is considering what economies may be effected by a change from steam to electricity. Some years ago the Bavarian Government, in considering what use should be made of the state water powers, decided that the best thing to do would be to use them for operating the state railways. Since then the question has been studied more fully, and recently a report has been issued discussing the electrification of the railways controlled by the state.

The Bavarian Government controls a little less than 4,000 miles of railway. To operate the system it is estimated that about 1,435,000 kilowatt-hours will be required each year. Allowing for losses in generation and transmission, it is figured that the average daily load will be about 142,000 horse-power. Allowing for the expected increase in traffic, the average daily load by 1920 should be a little over 200,000 horse-power, while the maximum load would be in the neighborhood of 606,000 horse-power. To supply this it is estimated that there is a minimum available horse-power in the waterfalls of 300,000, which can be considerably increased by proper storage arrangements.

The report considers the different electric railway systems available and decides that the single-phase is the most suitable for the work. It then discusses in some detail the cost of electrical operation and compares this with the cost of operating the roads by steam under the present arrangement. Different sections of the railroad are considered, and it is shown that a considerable economy should be effected. For example, for the section comprising about twenty-five miles in all, including the main line from Salzburg to Freilassig, with a branch running to Bad Reichenhall and Berchtesgaden it is found that something over $20,000 is available for supplying electrical energy, which allows about one cent per kilowatt-hour, while it is estimated that the actual cost for supplying this energy should not be more than three-tenths cent per kilowatt-hour.

The report concludes that electrification of the railways is possible, that the single-phase system seems to be the most suitable, and that the necessary energy can be obtained from the state's water powers. The roads in the southern part of Bavaria seem to be the most suitable for starting the work, since fuel is more expensive there and hydraulic power is cheaper. The other incidental advantages, such as avoidance of smoke, increase in traffic capacity and in speed, are pointed out, and attention is called to the fact that the price of fuel will increase in all probability. There is some question about the military aspect of electrification, but should this department not oppose the change, it is recommended that groups of lines be selected for electrification which are most favorably situated with reference to the water powers, and the traffic requirements of which are such as make them suitable for the change.

THE INSTITUTE CONVENTION.

The annual convention of the American Institute of Electrical Engineers is to be held this year at Atlantic City, N. J. The provisional programme of this meeting was published in the ELECTRICAL REVIEW for June 13, and from this it will be seen that although the meeting is to be held at one of the most famous seaside resorts in the country, plenty of mental exercise and entertainment will be provided. There are, in fact, over thirty papers listed, not including the presidential address. The subjects show a wide variety, so that there will be something of interest for every electrical engineer who attends, no matter in what particular line of work he is engaged. There should indeed be many opportunities for every one attending to learn something new, if not about his own work, at least about that of his neighbor, and thus put him in a better position to take a broad, clear view of electrical engineering as a whole, and, therefore, make him better fitted to carry on his own minor part of the work.

General Electric Company's Engineering Convention.

For nine days ended June 9, the engineers of the General Electric Company were gathered together at their annual meeting for discussing the past year's development in the art and considering plans for the future. Engineers from the local offices of the General Electric Company throughout the country and Mexico were in attendance, as well as representatives of all branches of the engineering departments of the company. Every phase of the company's engineering work was considered in detail. The engineers of the various departments presented interesting papers on a great variety of important subjects and profitable discussions followed.

The meeting was opened at the principal works at Schenectady, N. Y., by E. W. Rice, Jr., vice-president. After spending five days at Schenectady the meeting was adjourned to Pittsfield, Mass., where C. C. Chesney, manager of the Pittsfield works, opened the meeting and introduced the engineers at that factory. The meeting was continued at Lynn, Mass., where the engineers were welcomed by W. C. Fish, manager of the Lynn works. The company's incandescent lamps works are located at Harrison, N. J., and when the convention assembled at this place G. F. Morrison, manager, outlined the remarkable development in incandescent lamp engineering during the last year.

Among the engineers from the field present at this meeting were: J. Lyman, Chicago; J. L. Monges, San Francisco; W. F. Wright, Denver; H. H. Barnes, New York; C. T. Mosman, Boston; W. S. Culver, Cincinnati; L. F. Deming, Philadelphia; H. E. Bussey, Atlanta; W. H. Hand, St. Louis; C. A. Chase, Mexico.

National Electrical Contractors' Association.

The eighth annual convention of the National Electrical Contractors' Association will be held at the Auditorium Hotel, Chicago, Ill., July 15, 16 and 17. The registration department and the directors' room will be located on the parlor floor. The business sessions will be held in the hall on the sixth floor. All badges and tickets for entertainment features will be issued only at the registration department, and no badges will be issued until payment by the party registering of the fee for the tickets. The registration department will be open on the afternoon and evening of July 14, the day before the opening of the convention, for the convenience of those arriving on that day.

The men's banquet will be held in the banquet hall of the Auditorium Annex. The ladies' banquet will be held in a smaller room immediately adjoining the men's banquet room. Both banquets will be held at the same time—Wednesday evening, July 15. It has been decided to do away with the usual speechmaking, and after the conclusion of the banquet a vaudeville entertainment will be given on a stage at one end of the main banquet hall, and the ladies will be admitted to the balconies of the main banquet hall.

Thursday morning and afternoon the ladies will be given an opportunity to visit the large retail stores and various points of interest about the city. On Thursday evening there will be a theatre party for the ladies.

Friday will be devoted to an outing to Michigan City, Ind., *via* the steamship Theodore Roosevelt, leaving Chicago at 10 A. M. and arriving at Michigan City at 12.30 P. M. On arriving at Michigan City it is proposed to go directly to the large park, where all the amusements incident to a summer resort can be found.

Meeting of the Contract and Inspection Department of the New York Edison Company.

On Thursday evening, June 11, the regular monthly meeting of the contract and inspection department of the New York Edison Company was held in the Edison Auditorium on West Twenty-seventh street, New York city.

Several very interesting and instructive papers were read by members of the department, including "The Public Utilities Company's Dealing with the Public," by Walter Neumuller; "Electric Signs," by E. A. Mills; "A Few Thoughts Concerning the Competition of the Local Plant," by W. H. Whitton; "Work of the District Offices," by F. H. Kinnicut; "The Tungsten Lamp," by E. F. Tweedy.

At the conclusion of Mr. Tweedy's paper several lantern slides were shown giving the performance of the tungsten lamp, followed by views of lighting fixtures adapted for use with tungsten lamps, which were described by Mr. Mills.

Arthur Williams, general inspector, closed the meeting with a timely address on the activities of the department in the past and present, with valuable suggestions for work in the future.

Westinghouse Electric Statement.

The Westinghouse Electric and Manufacturing Company has issued a statement showing the assets and indebtedness with respect to the indenture controlling the issue of convertible sinking fund bonds. The statement of assets is dated April 30, and compares with the figures as of October 31, 1907, as follows:

ASSETS.

	Apr. 30, '08	Oct. 31, '07
Property and plant	$20,905,286	$20,698,404
Investments	30,820,452	30,104,454
Working assets	12,271,606	17,942,065
Quick assets:		
Cash	5,695,347	1,286,059
Accounts and notes receivable	8,608,668	9,031,554
Cash to be furnished by stockholders	6,000,000	
Other assets:		
Special deposit	1,535,120	1,535,120
Notes and accounts due by foreign Westinghouse companies in hands of receivers, etc.	2,364,748	3,738,972
Total assets	$88,201,227	$84,336,628

The company's statement of indebtedness as of April 30, 1908, is compared with the indebtedness as of the same date after the application of the Merchandise Creditors' Plan, as follows:

	April 30 1908	April 30 1908 (After application of Merchandise Creditors' Plan.)
Bonds and deb.	$20,469,000	$24,969,000
Collateral notes	8,702,703	8,702,703
Notes issued for cash	7,919,000	3,419,000
Notes issued for merchandise	1,290,766	1,433,482
Current accounts for merchandise	4,142,715	
Interest accrued on funded and floating debt	708,586	708,586
Subscription accounts.	402,000	402,000
Total debt	$43,634,770	*$39,634,771

* The reduction of $4,000,000 in the total debt, after the application of the Merchandise Creditors' Plan represents the assenting capital stock to be issued to Merchandise Creditors or others in settlement of floating debt. In addition to securing this reduction in debt, the assets will be increased by the $6,000,000 cash to be provided by the stockholders.

The statement does not include contingent liabilities. As of October 23, 1907, these amounted to $3,146,256, and have been reduced to $1,999,094.

To Investigate Telegraph Companies' Operations.

Under the provisions of a resolution recently adopted by the United States Senate, Oscar S. Straus, secretary of the Department of Commerce and Labor, has arranged for an investigation of the operations of the telegraph companies of the country. The inquiry will extend into receipts and expenditures, wages paid, conditions of employés, hours of labor, etc. Secretary Straus has placed the investigation in the hands of Charles P. Niell, commissioner of labor, and Herbert Knox Smith, secretary of corporations. The report will be ready for the Senate when it reconvenes next December.

ENGINEERING OF THE MECHANICAL EQUIPMENT OF A LARGE STORE BUILDING.

BY PERCIVAL R. MOSES.

The building for which the equipment described was designed is one of the highest class, and is located on the east side of Fifth avenue, New York city. The business is solely the sale of dry goods; that is, silks, cloths, rugs, draperies, gloves and other articles of wearing apparel; no furniture, except small fine pieces, is sold, nor any household utensils. A large part of the upper floors is devoted to making of dresses, waists, coats, etc., and alterations.

The building will be described to give an idea of the quantities involved and the conditions. After this the steps followed in design of the equipment, the reasons leading to the choice of the different types of apparatus and systems, their sizes and characteristics will be discussed, and the work of preparation of plans and specifications described, touching on the more important points of such specifications and plans; and finally the rest of the engineering supervision of the work, including the receipt of estimates, inspection and approval of contracts, approval of drawings and materials, preparation of final drawings, inspection of installation and inspection of manufacture, and final tests and certificates will be detailed.

This equipment has been chosen as a basis for a paper, as its problems include heating, lighting, power supply, ventilation, fire protection, electric signaling, electric heating, and indeed all the factors that enter into the design of any building equipment, except such special apparatus as may be required for special work.

The building covers a plot approximately 200 by 300 feet, with a small corner, 100 by twenty, cut out for the present. It is eight stories above the ground, with basement extending over the whole area and a sub-cellar extending over about one-half the area. The total cubical contents of the building is approximately eight and one-quarter million cubic feet, deducting all court area. The total floor area, including basement and sub-basement, is 520,000 square feet, and the total area contained in the customers' floors, which are the ground floor, second, third and fourth floors, is 210,000 square feet.

The store is designed with a large central court or rotunda covered over at the fifth floor with an ornamental glass dome, and again covered over at the top of the building by a skylight. There is a great deal of glass surface and exposed wall surface, the windows coming down to within two feet of the floor and occupying a large proportion of the walls. The stories are high, the first floor being twenty feet; second floor, sixteen feet; third floor, fifteen feet; fourth floor, fourteen feet, and the upper stories, thirteen feet six inches high in the clear.

The elevator equipment includes thirteen main passenger, two special, four freight and service, and one sidewalk elevator and three electric dumbwaiters.

There are 1,450 arc lights, and outlets with a capacity of 8,136 sixteen-candle-power incandescent lights, 600 horse-power of motors driving fans, blowers for pneumatic cash system, sewing machines, pumps, etc.

Electricity is also supplied for heating irons, glue pots and other utensils, for winding clocks, signaling, automatic gas lighting and fire protection.

There are 20,000 square feet of direct-heating surface in the form of coils and radiators, and 10,000 square feet of indirect-heating surface in the form of wrought-iron pipe stacks.

Fresh tempered air is supplied to the first floor and basement by four main fresh-air supply fans having a total capacity of 200,000 cubic feet of air per minute. Three main exhaust fans having a capacity of 150,000 cubic feet of air per minute take away the air from basement and sub-cellar. Two smaller supply fans are installed for vestibule heating, and one small exhaust fan for toilet ventilation.

The power plant consists of eight high-pressure water-tube boilers having a rated capacity of 2,100 horse-power; five direct-connected medium-speed Corliss valve steam engines operating 115-volt, direct-current dynamos, three of these sets having a capacity each of 500 kilowatts for two hours, or 400 kilowatts continuously, and the two smaller sets having a capacity of 250 kilowatts each for two hours, or 200 kilowatts continuously.

PRELIMINARY DESIGN OF PLANT.

In making the preliminary design of the equipment of such a building it is first necessary to tabulate data showing the probable quantities of electricity that will be used for lighting, for power and other purposes at different periods of the day and year, and also the quantities of steam that will be used for heating, and the quantities of steam that will be obtainable at low pressure, as exhaust steam from the engines, pumps or other apparatus. There is only one way of getting these data, and that is to obtain figures showing the actual requirements in other installations of similar character, not merely one installation, but a number more or less similar, and with these as a guide prepare a table showing the probable use for the building in question, making due allowance for differences in construction and character of service. Therefore, curves showing the light and power requirements in one of the principal store buildings in New York city were used as a basis for the design of this building equipment.

The load curve as figured in the preliminary design was as follows: In winter, from 8 A. M. to 5 P. M., from 750 to 800 kilowatts; from 5 P. M. to 6.15 P. M., from 900 to 1,000 kilowatts; from 6.15 P. M. to 7 P. M., from 350 to 400 kilowatts; from 7 P. M. to 9 P. M., from 200 to 300 kilowatts; from 9 P. M. to 12 midnight, 200 to 250 kilowatts; from midnight to 8 in the morning, from 125 to 150 kilowatts. In summer, from 8 A. M. to 7 P. M., 500 to 600 kilowatts; from 7 P. M. to 11 P. M., from 200 to 350 kilowatts; from 11 P. M. to 8 A. M., from 125 to 200 kilowatts. These figures include light and power.

The maximum heating requirement was figured at 25,000 pounds of steam per hour, and the average requirement in cold weather about 17,000 pounds of steam per hour. This preliminary estimate of the steam required was based on the quantity of coal required to heat buildings of similar character. The quantity of steam available per hour from the electric plant and other apparatus, using the most economical engines, was estimated for average winter requirements at:

	Lbs.
Electric plant	25,000
Elevator pumps	6,500
Ice machine and auxiliaries	4,000
Total	35,500

The maximum steam requirements per hour were estimated as follows:

	Lbs.
Electric plant	30,000
Elevator pumps	10,000
Ice machine and auxiliaries	7,000

In the design of this plant provision was to be made in the smokestack for additional capacity sufficient to take care of a building about three-eighths larger than the present building.

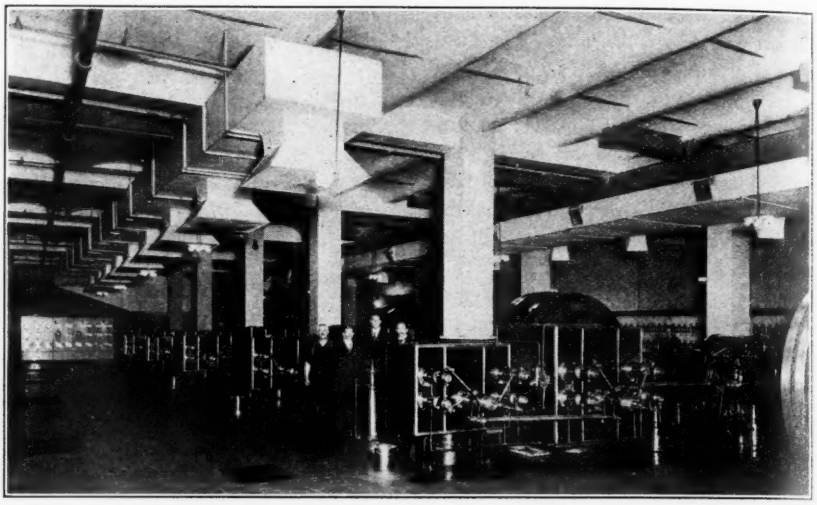
This plant was designed for the use of small low-grade fuel capable of evaporating seven pounds of water into steam per pound of fuel. Allowing a rate of combustion of fourteen pounds of coal per square foot of grate surface for the average maximum, the total grate surface required was 470 square feet for the present equipment without any spare units, and the boiler horse-power required, without

spares, 1,600. The location of columns was such that with a maximum depth of grate of eight feet it was necessary to divide the units into three batteries of two units each, approximately 250 horsepower each, and two units of 300 horsepower each, thus allowing one battery or one unit to be kept in reserve at all times. The question of available grate area was in this case, as in almost every other case, a determining factor, as there was sufficient head room to allow much greater boiler capacity in so far as the tube surface was concerned, but without the grate surface on which to burn the fuel to supply the heat units to be absorbed by the tube surface, there was no advantage in increasing the quantity of tube surface.

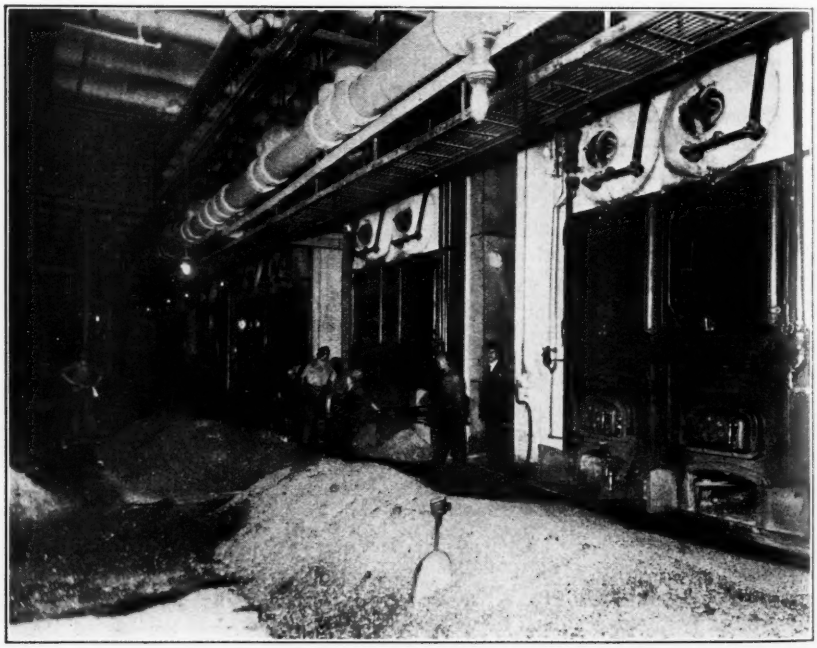
Before proceeding with the preliminary design of the plant, all available means of obtaining a supply of electricity and steam were considered, *i. e.*, electricity could be purchased from a central station, or it could be generated in an isolated plant. There was no central steam supply available, so that a steam plant was required for heating the building, whether electricity was purchased outside or not. If electricity were purchased from a central station it could be purchased for lighting only, or for lighting and for driving the ventilating fans and elevator pumps, cash system and other motors. The use of electricity from a central station for driving motors for elevator pumps was first abandoned as the requirements of steam for heating the building for seven months in the year were such that the cost of operation of the elevator pumps in so far as fuel was concerned would be practically nothing, as all the exhaust would be used for heating. Careful estimates were made of the cost of operation of the heat, light and power equipment with a private plant, and a figure obtained for supplying the electricity for lighting and purposes other than elevator operation. An extremely low rate per kilowatt-hour was offered on account of the large guaranteed use of current and the great advertising benefit to be derived from the supply of so large a equipment by the central service.

It was found that the cost of manufacturing electricity on the premises would be less than sixty per cent of the cost of purchasing it outside after including the cost of manufacture, the interest and depreciation charges on the cost of installation. The cost of installation on which these fixed charges were figured included not only the cost of engines, dynamos, switchboard and steam and wiring connections to plant, but the additional boilers and the excavation and preparation of the additional space necessary for the installation of the power plant.

The total cost per kilowatt-hour was estimated to be a little more than one and four-tenths cents, of which 0.62 cent is fixed charges and 0.80 cent is manufacturing cost. The saving by the private plant was estimated at more than $22,000 per year, or over fifteen per cent in addition to fixed charges on the investment.



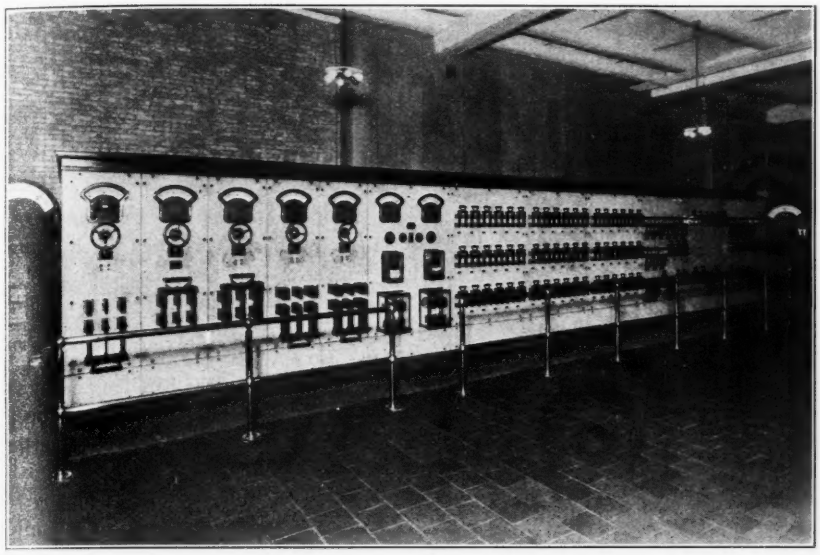
ENGINEERING THE MECHANICAL EQUIPMENT OF A LARGE STORE BUILDING. GENERAL VIEW IN ENGINE ROOM.



ENGINEERING THE MECHANICAL EQUIPMENT OF A LARGE STORE BUILDING. A VIEW IN THE BOILER ROOM.

The cost of electricity was determined by estimating in detail the cost of operating the whole equipment, purchasing electricity from a central station, and the cost of supplying everything from a private plant. The difference between these two costs is the cost of manufacturing electricity, and this cost divided by the number of kilowatt-hours gives the cost per kilowatt-hour. The low cost in this instance per kilowatt-hour is due to the large quantity to be furnished and the high class of skilled labor required in a building of this character, whether a plant is installed or not. Skilled labor is needed for the care of high-speed plunger elevators, cash-tube apparatus, large heating plants and ventilating systems, whether an electric plant is installed or not; and the installation of the electric plant adds mainly to the quantity of fuel burned, which is low-grade cheap fuel, and the

quantity of low-pay labor, such as firemen and oilers. The value of the exhaust steam for heating is not a determining factor in such installations, as the exhaust steam available from pumps and other apparatus goes a long way toward heating the building.

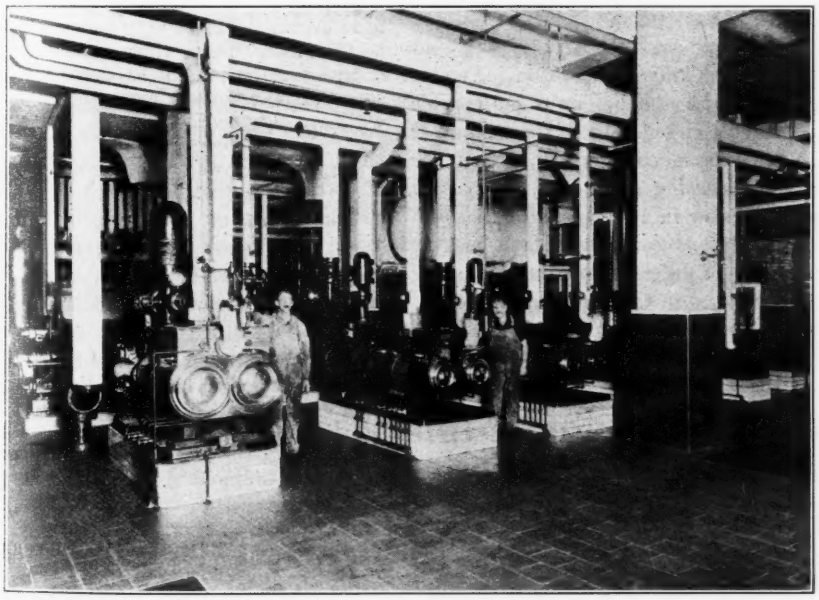


ENGINEERING THE MECHANICAL EQUIPMENT OF A LARGE STORE BUILDING. THE SWITCHBOARD.

In estimating fixed charges the interest is figured on the whole cost at five per cent. and depreciation is figured at five per cent on all machinery and two and one-half per cent on all building and similar work. These items are higher than practice would warrant, but they are the usual rates adopted by disinterested engineers.

With a properly designed isolated plant with duplicate supply and exhaust mains and duplicate water connections, a shutdown, except through earthquake, could only be caused by the employment of unskilled engineers and extremely bad management.

Of boilers, the three main types, water-tube, marine or horizontal tubular boilers, were considered. Horizontal tubular boilers were not adopted for this service on account of the high steam pressures to be carried, 150 pounds per square inch, and the large size of units. Up to 150 horsepower with steam pressures of 100 pounds per square inch or less a horizontal tubular boiler has no superior in efficiency, ease of maintenance or low first cost. With higher pressures and larger sizes the thickness of the shells becomes too great, and some form of divided heating surface must be used. The water-tube boiler of the Babcock & Wilcox type was chosen in preference to the marine type, because of ease of repair and maintenance and greater safety.



ENGINEERING THE MECHANICAL EQUIPMENT OF A LARGE STORE BUILDING. FIRE, HOUSE AND VACUUM PUMPS.

In the choice of engines, a medium speed of 150 revolutions per minute was chosen in preference to low-speed Corliss or the high-speed automatic cut-off four-valve engine. The preference was given over the Corliss low-speed on account of direct connection with the dynamos, less space requirement, hence lower total annual operating cost. And the compound non-condensing engines were chosen instead of simple engines because of superior economy. They were not designed to run condensing, because this would have necessitated a cooling tower in order to reuse the condensing water, and the fixed charges on the cost of condenser, pumps and cooling tower more than balanced any saving that could be obtained in fuel.

Direct-connected dynamos were chosen instead of alternating current on account of the large motors, lower first cost of apparatus, greater simplicity, and further because more illumination is obtained per unit with direct-current arc lamps than with alternating-current arc lamps. The voltage chosen was 110 volts. It was possible to obtain these 110 volts either by winding the dynamos for 110 volts directly or by using three-wire dynamos operating at 220 volts, but giving 110 volts between each pair of wires.

In considering the question of lighting the choice lay between arc lighting for the large spaces and incandescent or Nernst lamps. Arc lighting was chosen because of the whiteness of the light, which is of major importance in a store dealing in colored goods, and also because of its lower cost of operation.

Incandescent lamps in small units were used entirely for localized lighting, such as showcases, as this light is particularly suitable for such work.

In the determination of the kind of heating system to adopt, steam was preferred to hot water on account of its lower first cost and lesser amount of radiating surface and lesser complication of apparatus. The direct-heating system with radiators and coils was adopted for the floors above the ground floor in preference to the indirect system because of lower operating cost.

The indirect heating system was adopt-

ed for the first floor because of the necessity of fresh air and ventilation on account of the large crowds which at certain times of the year will fairly fill the first floor. This system is also used in the basement, because the only way to get fresh air is to blow it in.

There are two systems in general use for supplying the steam to radiators, one running the mains in the basement and feeding up, the other running the mains under the roof and feeding down. The latter was adopted because of the quantity of conveyer ducts and cash tubes and sprinkler pipes in the basement, also because it is less expensive to install, and the heat radiation from the mains is useful on the top floor, while it would be a detriment in the basement. Further, the size of risers running through the first floor is reduced to the size of a drip pipe.

The two-pipe system is used with automatic thermostatic trap valves on the drip from each radiator and pumps in engine room sucking condensed water away continuously. This vacuum system was adopted to do away with back pressure on the engines and insure perfect circulation through the coils or radiators, and also to allow the steam in radiators or coils to be turned on partially without water-hammer.

In deciding upon the type of pumps for boiler feed and house service, steam-driven duplex and simplex pumps and electric-driven triplex and centrifugal and rotary pumps were considered. Both steam and electric pumps were adopted for house service, the electric pumps to be run in summer on account of superior efficiency. Steam pumps were used for boiler-feed purposes because of their greater simplicity and easier speed adjustment, and these pumps were of the outside packed plunger type on account of the high pressure against which they were to work and the necessity of a positive displacement when pumping hot water.

For low lifts, such as drainage, the electric centrifugal pumps were used because of their simplicity and ability to handle gritty water. They were not adopted for high lifts because of their inefficiency.

In the choice of elevators the hydraulic plunger was chosen in preference to the hydraulic horizontal or vertical cylinder type, because of its low cost of repairs, efficiency and safety.

In deciding on the type of pumps for these elevators, the high-duty pump was chosen for regular operation, on account of its economy over the ordinary compound duplex pump, but two of these compound pumps were also installed to act as spares and for night service.

With the types of apparatus settled, it was only necessary to determine on the sizes to complete the preliminary design. The reasons governing the choice of the sizes of boilers have been partially treated. The load curve showed that the average boiler horse-power during the winter should be between 1,200 and 1,400, with a peak-load requirement of 1,800. It would have been possible to install three 500-horse-power boilers and two 300-horse-power. This would mean that, if the three large boilers were in operation, the cleaning of one or any mishap occurring throwing one of the boilers out of commission, would throw too great a load on the other two, while under the plan decided upon, with six 250-horse-power boilers and two 300-horse-power the cutting out of one of the boilers would still leave the others capable of handling the load. For all practical purposes the two 250-horse-power boilers act as one boiler, except that the subdivision gives added safety.

The size of the engines and dynamos was fixed by the load conditions. The load of from 750 to 850 kilowatts, which it is estimated will be the average load during the winter months, can be carried readily by two 400-kilowatt units, and these 400-kilowatt units have overload capacities sufficient to carry a peak load of 250 to 300 kilowatts additional if necessary. The two smaller units are capable of replacing either of the big ones, and, at the same time, one of them is not too large to run the night load, or may be used to throw in at the peak of the load. The conditions could have been met by four units of different sizes, but by having only two sizes in the plant a complete set of repair parts for each size can be readily maintained.

(To be concluded.)

Annual Meeting of the Electric Properties Company.

At the annual meeting of the Electric Properties Company the retiring board of directors was re-elected, and Horace E. Smith was elected to fill a vacancy in the board. The directors organized by electing John F. Wallace president and the following executive committee: Charles A. Allen, N. W. Halsey, Paul D. Cravath, F. D. Underwood, R. B. Van Cortlandt and John F. Wallace, Mr. Wallace being an addition to the committee.

FINANCIAL REPORTS OF ELECTRIC COMPANIES.

AMERICAN RAILWAYS COMPANY.

The subsidiary companies of the American Railways Company report gross earnings for May and eleven months ended May 31, as follows: May gross, $246,897, a decrease of $2,272 from the figure for the same period of 1907. Eleven months' gross, $2,641,896, an increase of $51,547 over the same period in 1907.

TAMPA ELECTRIC COMPANY.

The Tampa Electric Company has sold to a syndicate composed of Redmond & Company, of New York, and Warner, Tucker & Company, of Boston, $600,000 first-mortgage, five per cent bonds maturing June 1, 1933, which are being offered to the public by the bankers and by Stone & Webster, general managers of the property, at ninety-three and one-quarter, to yield five and one-half per cent.

The Tampa Electric Company operates the equivalent of forty-one miles of single track, of which thirty-one miles are in the city of Tampa and ten miles interurban line to Port Tampa. The system serves a population of about 45,000. Gross earnings have expanded during the eight years of the company's existence from $152,123 in 1900 to $521,181 in the fiscal year ended December 31, 1907, an increase of over 200 per cent. Net earnings for the eight years of the company's operation have averaged $126,000, which is slightly better than four times the interest charges on the present $600,000 bond issue, the only lot of bonds the company will have outstanding.

RUTLAND RAILWAY, LIGHT AND POWER COMPANY.

The report of the Rutland Railway, Light and Power Company, of Rutland, Vt., for the twelve months ended May 31 shows gross earnings of $254,556; expenses, $142,015; net, $112,541. This compares with a net return of $95,258 for the same period in 1907. Of the net earnings for the period ended May 31, those of the gas department were $12,650; of the water power and electric light department, $52,450, and of the railway department, $47,440.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of May and five months ended May 31 shows gross earnings for May of $503,357; expenses, $292,790; charges and taxes, $36,107; May surplus, $174,460. Five months' gross, $2,552,614; expenses, $1,489,999; charges and taxes, $187,635; five months' surplus, $874,980.

BOOK REVIEWS.

"Questions and Answers in Electrical Engineering." A. E. Moore and Frank Shaw. New York. Longmans, Green & Company. Cloth. 152 pages. Illustrated. 5 by 7½ inches. Supplied by the ELECTRICAL REVIEW for ninety cents.

This is a compilation of questions which have been set by the City and Guilds, of London Institute, in the preliminary grade of electric lighting, from 1899 to 1907, inclusive. The book gives also the solutions to all the questions.

"Engineers' Descriptive Charts." Joseph G. Branch. Chicago. Rand, McNally & Company. Cloth. 75 pages. Illustrated. 6 by 9 inches. Supplied by the ELECTRICAL REVIEW for $1.

This book contains a number of colored charts illustrating the principles of operation of various types of the steam boiler, selected types of steam engine, and a few of the important electrical experiments, such as Oersted's and Faraday's arrangements for illustrating electromagnetic action, and several charts showing the operation of an electric generator. Accompanying the charts are questions and answers on the apparatus illustrated.

"Electric Power and Traction." F. H. Davies. New York. D. Van Nostrand Company. Cloth. 294 pages. Illustrated. 6 by 8½ inches. Furnished by the ELECTRICAL REVIEW for $2.

This book has been written with the object of offering, in suitable form, a good deal of information concerning electrical apparatus for those who have not made a special study of electrical science. The application of the electric motor for power purposes has spread so rapidly that it is becoming necessary for all engineers and those connected with industries in which the motors are being introduced to learn something of their characteristics and peculiarities, and the means by which they have been adapted to various purposes. The author first discusses the subject of generation and distribution of power, both by means of direct currents and alternating currents. He then describes types of motors, and shows how they work, following this with a more detailed consideration of the application of electric power in mines, workshops, textile factories, printing and at sea. The use of the electric motor for traction purposes is next considered. Then the various systems of canal haulage and electric railways are described, nearly one-half of the book being given up to the last two subjects.

"Electricity. What Is It?" W. Denham Verschoyle. New York. The Macmillan Company. Cloth. 260 pages. Diagrams. 5 by 7½ inches. Furnished by the ELECTRICAL REVIEW for $1.

Holding the view that a purely imaginative explanation of the universe may be as strictly true as one based on mathematical deductions, the author of this book undertakes to build up in a purely speculative way a theory which will account for all natural phenomena. He postulates first an ever-present medium such as the ether, and conceives matter to be formed of groups of elementary bodies, each of which is merely a gyratory disturbance in the ether. To avoid confusion with other hypotheses, he terms this fundamental element the "gyron." The gyron corresponds to Thomson's corpuscle, but has no material existence other than that due to its motion. On account of the forces set up through the ether from these gyratory centers, the forces set up by these particles are of three kinds: those due to the motion of the periphery of the gyrons, those due to the motion of its sides and those caused by the translation of the gyron through the ether. When the gyrons are properly oriented, forces due to the motions of the sides will cause them to attract one another. This is supposed to be force of gravity. The gyrons, when they come into favorable positions, tend to group themselves, first in pairs, and then in more complex groups, forming various harmonic series.

Consideration of the most likely groupings of gyrons shows that they correspond to the relative values of the atomic weights of the elements. The numerical relations of the atoms are then gone into at some length, and a remarkable agreement between the computed weights, according to the author's theory, and the actual weights is shown. Having thus constructed a mathematical table of the chemical atoms, the same method is pursued to build up the molecule, and it is here shown why, according to the theory, certain atoms will combine more readily with certain others. Having now built up a theory to explain matter, the forms of energy known as heat and light are discussed, these being considered motions of the gyrons, groups of gyrons, sub-atoms, atoms, and of the molecules themselves. Although the gyrons are attached more or less firmly to atoms and molecules, some of them may, under certain conditions, be released to pass from one to another. This constitutes a transfer, or flow, of electricity. The forces set up by this motion of the gyrons are electromagnetic.

Dissociation and devolution are then considered, the first being the forcible separation of particles; the second being a natural change or decay by means of which energy is transferred from the dying atom to another. Life is explained in much the same way. Organic bodies are those which are going through a constant stage of evolution, coming into existence, giving rise to other similar bodies, and finally breaking up. This process must have been started at some period of time, for we know of no spontaneous generation, but it may be that the primary cause was a highly complex atom, which is not now in existence. It has also been necessary to assume some origin of the gyron, or whirl, in the ether. It is utterly impossible to define what this was, but it has been called absolute energy, thus putting it in the same category as the ether. The book, while admittedly entirely speculative, is intended to lead to a logical arrangement of our knowledge of natural phenomena, rather than to point out plans for increasing this knowledge. It will furnish interesting reading for those philosophically inclined, and the style and entire absence of mathematical argument will make it understandable by any with a slight scientific knowledge.

Electrical Porcelains.

The manufacture of porcelain for electrical purposes was recently discussed before the Birmingham and District (England) Electric Club by H. W. Brady. An abstract of his paper follows. That part dealing with the selection, preparation and mixing of the clays is interesting. The substances employed for manufacturing insulators are all clays, or closely related to the clays. They have been formed by the action of the weather on feldspathic rock, such as granite and porphyry. This process washes away practically all the materials except the aluminum silicate, which in the pure form is known as kaolin. This is the basis of all clays, and the several varieties of clays are due to other different substances included in their composition. Clays are classified in the following way: Strong clay is rich in iron, and used for making bricks. Mild or loamy clay contains gravel and sand, which must be washed out. The texture of this clay is loose, calling for an addition of chalk to act as a flux. Marl is a clay containing a considerable amount of chalk, which is useful for brick-making. Plastic or potter's clay occupies an intermediate position between the colored-burning common clay and the white-burning china clay. The cause of its extreme plasticity is not certain. This is usually called ball clay, and is frequently colored by organic matter. Fire clay is simply highly refractory clay, and hence the best fire clay is the purest. Kaolin, or china

clay, is the finest kind of clay. It is the most distinctive ingredient in the composition of porcelain. It is less plastic than the commoner clays, and when burnt becomes white and porous. In its finest form it is used for porcelain; in its less pure form it is used for ware intended to withstand very high temperatures. The latter is not true porcelain, as it exhibits no translucency. Kaolin, however, usually contains some impurities which must be removed by washing. It is generally allowed to stand in the open for some time to weather. For this purpose as large a face of the quarry as possible is exposed. It is easily crumbled when dry to a fine powder and takes up a large quantity of water, which makes it plastic and tenacious. When molded into shape and allowed to dry, it toughens and becomes feebly coherent. If fired, it shrinks about eight per cent and becomes hard, though it does not fuse. The formula for mixing clays for insulator pottery are usually secret, but the following is a mixture which is in use. This consists of three parts of china clay, twelve parts of ball clay, two parts of flint, two parts of Cornish stone, and four parts of feldspar. The preponderating portion of this is ball clay. The latter gives plasticity and ductility to the mixture, making it easy to work. The flint counteracts the shrinking and liability to crack and the distortion which would take place due to the fusibility of feldspar. Feldspar and Cornish stone are the fluxes, and both seem to be necessary for success, but neither one alone gives the desired result. It is not a little peculiar that the five ingredients called for above seem all to be necessary for successful porcelain-making, although they are all so similar.—*Electrician (London), May 29.*

Notes on the Electrical Engineering Department, Massachusetts Institute of Technology.

The faculty of the Massachusetts Institute of Technology has just conferred the degree of master of science on three graduate students in the electrical engineering course: R. B. Anthony, a graduate of the University of Wisconsin; E. L. Moreland, a graduate of the Johns Hopkins University, and F. W. Willey, a graduate of Purdue University. Thirty-eight students, ten of whom are already graduates of liberal arts courses and three graduates of the mechanical engineering course of the institute, have been granted the degree of bachelor of science in the electrical engineering course.

Graduate fellowships for electrical engineering study during the next year have been granted to Walter S. Rodman, now instructor in electrical engineering at the Rhode Island Agricultural College, and H. S. Osborne, who graduates from the electrical engineering course of the institute this year and who has been elected Saltonstall Fellow.

In connection with the lectures on electric light and transmission of power during the last term, A. S. Michener, comptroller of the Stone & Webster organization, lectured to the senior students in electrical engineering on the theory of accounting and the relations of the engineering, operating and executive departments to the accounting department, and R. A. Phillip, of the Stone & Webster Engineering Corporation, lectured on modern switching practice with high-tension circuits. Last term Walter Goodenough, of the same company, lectured on boiler-room practice in connection with the course.

Annual Meeting of the National Electrical Trades Association.

The annual meeting of the National Electrical Trades Association was held in Philadelphia, Pa., on Thursday, June 11. Delegates at large were as follows: Norman Marshall, representing the New England section; John H. Dale, representing the New York section; C. M. Wilkins, representing the Pittsburg section; James S. Woolf, representing the Chicago section and Mr. Van Valkenberg, representing the Pacific Coast section. There were twenty-five representatives altogether in attendance.

The following were elected officers for the ensuing year: President, C. M. Wilkins, president Patrick, Carter & Wilkins; vice-president, Norman Marshall, president Marshall Electric Manufacturing Company; secretary-treasurer, Frederic P. Vose, attorney, Chicago.

The attendants were the guests of the Philadelphia Electrical Trades Association, with which they made a trip to Atlantic City, N. J.

Railroads and Wood Preservation.

The board of directors of the Railway Engineering and Maintenance of Way Association has appointed a committee of seventeen to investigate and report upon the subject of wood preservation. A. L. Kuehn, engineer of track and roadway, Cleveland, Cincinnati, Chicago & St. Louis Railway, is chairman of the committee.

Inspection of Tunnels of the Niagara Falls Power Company.

In order that divers might examine the American abutment of the upper steel arch bridge the floodgates to the Niagara Falls Power Company's tunnel were shut down at midnight, June 13. The tunnel leads from the turbines above the falls to the base of the bridge. During the last three years the abutment has shown signs of such a battering that the safety of the structure was feared. A concrete wall two and a half feet thick has been beaten away. An attempt a few months ago to place ten tons of steel armor against the abutment failed, the steel being torn from the bridge cables and crumpled up in the river, and there was no other way to examine the abutment than to turn off the water.

The United States Government took this opportunity to determine if the falls have been damaged by the use of the water by the power companies. Major Charles W. Kutz, U. S. A., a member of the Taft commission, was on the scene to take observations and measurements. Readings were taken all along the river, and although the waters rose one-tenth of an inch at the brink just at the close of the shutdown, folk who watched the cataract all day could see no change.

The engineers found the bridge as solid as a church, although they admitted a new foundation might have to be built on the American side. R. S. Buck, who built both foundations, and Franklin Moran, who laid the foundation of the Singer Building, looked at the structure. The foundation of shale on which stands the protecting wall for the abutment of the big bridge has been undermined by the current. They decided that a firmer foundation might be secured by going down about sixty feet with concrete.

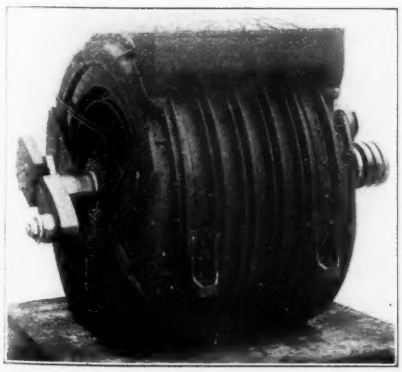
The Niagara Falls Hydraulic Power and Manufacturing Company closed down its floodgates to make the shutdown on the American side complete so that the government engineers might observe the changes in the cataract. The wheel pits of the Niagara Falls Power Company were stopped at midnight, and at four o'clock the other company shut down.

About sixty persons made the trip through the tunnel. It is understood that there was not a brick displaced and not a mark of erosion in the big tube was to be found in all its mile and a half of winding from the upper rapids to where it carries its load to the river below.

The New Ganz Three-Phase Locomotive.

By C. L. Durand.

THE new electric locomotives which have been constructed by Ganz & Company, of Budapest, Hungary, present considerable interest from different standpoints. The present locomotives were built for the Italian railroads, which are under the control of the government, and were ordered after the successful operation of the preceding locomotives which were built by the same firm and which have already been described in these columns. In external appearance the new type is about the same, and it operates on the three-phase system. However, there is a considerable difference as regards the arrangement of the motors, as well as the construction of the latter. The new locomotive adheres to the former design which proved quite successful from a mechanical standpoint, and when first brought out was of a somewhat original character. In this case the motors are mounted on either side of the centre of the locomotive. Each motor has a projecting crank at the side, and the two cranks are cross-connected by a horizontal bar of short and stout construction. In the centre of the bar is a joint which is adapted to receive the ends of the driving bars which are connected to each of the main driving wheels of the locomotive. In this way the action of the motors upon the combined set of driving bars carries out the movement of the main wheels in a very effective manner. The present system suppresses the use of gearing entirely, which is a great advantage. The upper cross-bar is balanced by triangular counterweights, one of which is



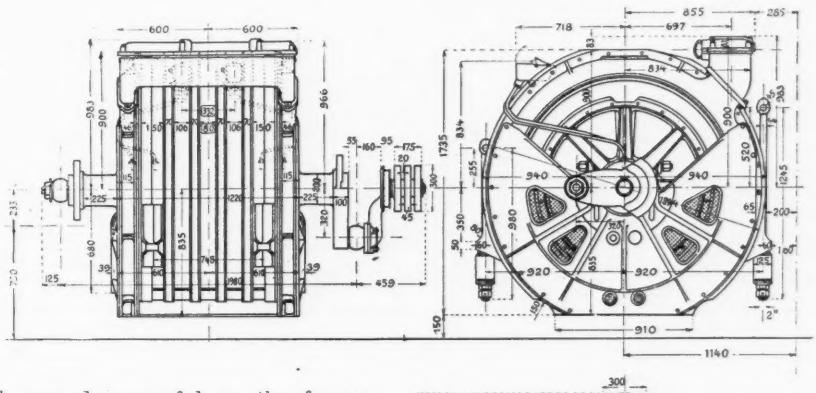
THREE-PHASE MOTOR.

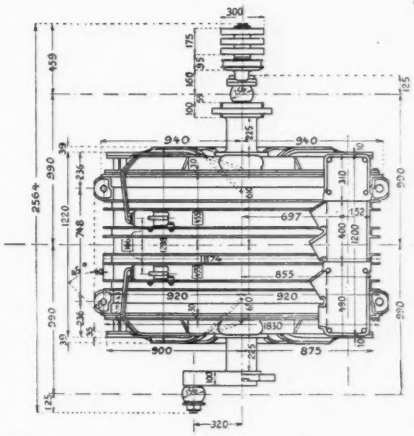
mounted upon each of the motors. On each side the locomotive carries, therefore, three main driving wheels and two small running wheels at the ends.

On the roof of the locomotive are mounted two trolley devices, which are of about the same construction as those which proved successful on the former Valtellina locomotives. These trolleys are formed of a straight cross-bar which is of some length and therefore is always in contact with the wires. The cross-bar has an insulated metallic portion at either end which comes under each of the two wires. A compressed air system is used for raising and lowering the trolleys, this being controlled by a set of valves in the motorman's cabin. The different switching apparatus of the locomotive are also operated by compressed air, together with the water resistance.

The general appearance of the new three-phase motor is well shown in one of the engravings herewith. Its general construction, as a whole, is somewhat the same as the former motor, but it differs from this in the winding and also from the fact that it is built of laminated iron and forged plates entirely, thus avoiding the use of cast-iron pieces. This is found to be a decided advantage in this class of motor. In general, the new motor is of cylindrical form and contains a rotor and stator. The rotor carries a three-ring collector, and it will be noticed that the latter is mounted well outside the motor, upon the end of the crank of the driving bar. In this position it is quite accessible from the side of the locomotive. The brush-holders are fixed above and upon the locomotive frame, being housed in a removable sheet-iron case.

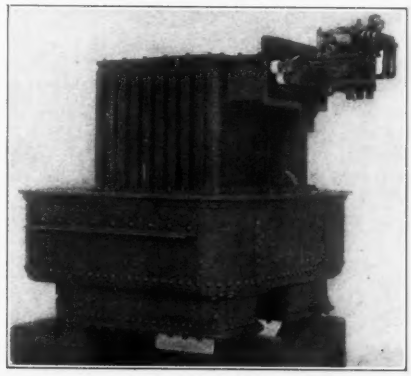
What is specially to be noticed in regard to the present locomotives is the arrangement of the motors, which allows for the use of three speeds. In the former locomotives only two speeds were employed and up to the present the general practice in the three-phase system is to use two main speeds at most, these being obtained by series switching or by pole changing.





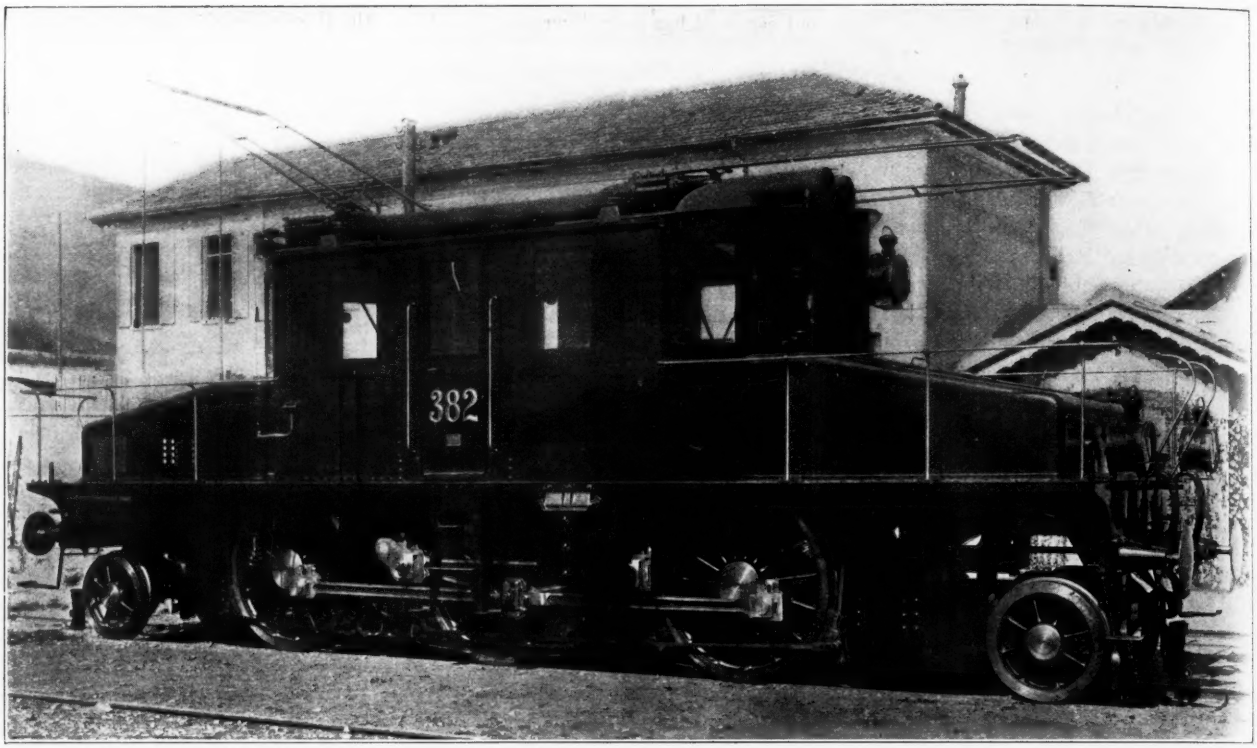
ELEVATIONS AND PLAN OF THE TWELVE-POLE, THREE-PHASE MOTOR HAVING THREE SPEEDS.

However, it is of advantage to be able to use three speeds, and the present arrangement of motors was adopted with this end in view. Of the two motors which are now

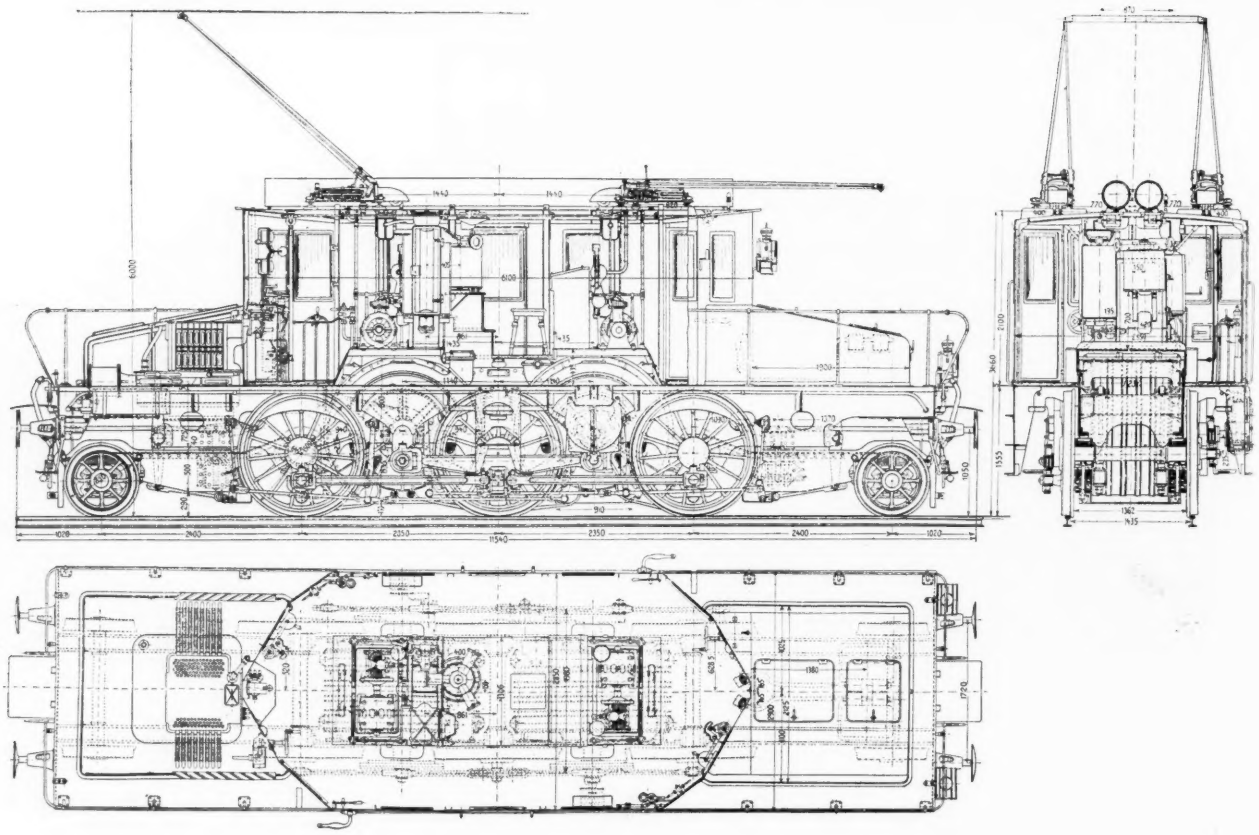


WATER RHEOSTAT.

mounted on the locomotive, one is an eight-pole motor, while the other has twelve poles. Each of the motors is designed to use the line current of 3,000

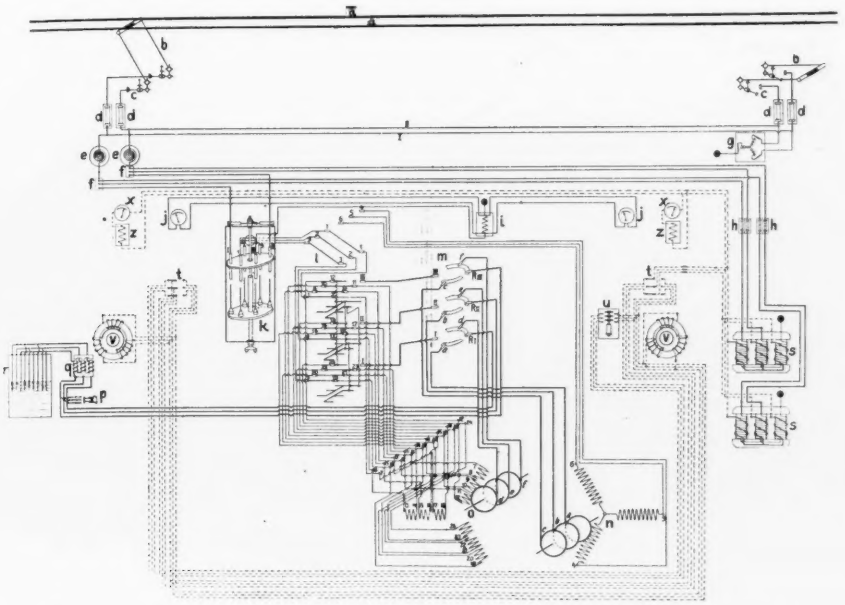


The New Ganz Three-Phase Locomotive.



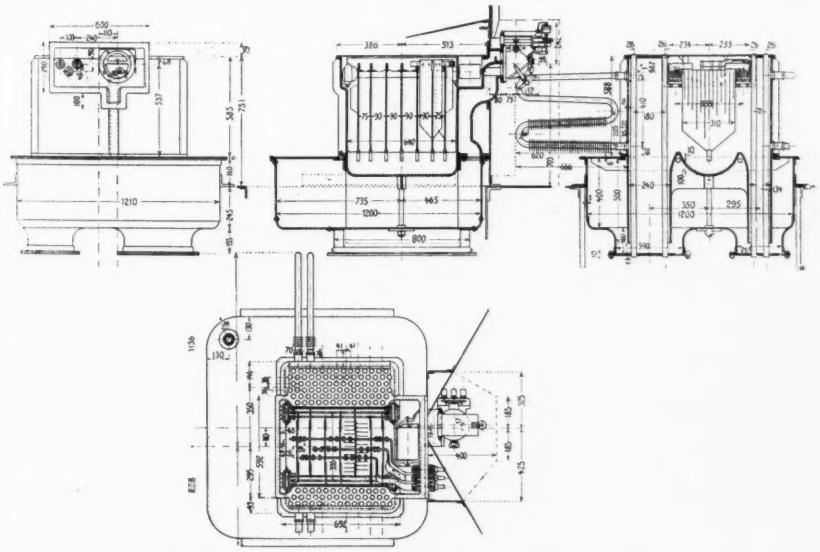
Arrangement of the Apparatus on the Three-Speed, Three-Phase Locomotive for the Italian State Railways.

volts upon its terminals. This current is generated at fifteen cycles, which is found to be the best adapted for the present case. To obtain the three main speeds the following method is adopted: For the two highest speeds one or the other of the motors, and this was adopted in the present case. It has proved very successful in actual practice, especially in the case of high-power motors. One point also is that it allows of frequent starting of the motors without any drawback. The pres-



SWITCHING DIAGRAM FOR THE THREE-PHASE LOCOMOTIVE GIVING THREE SPEEDS.

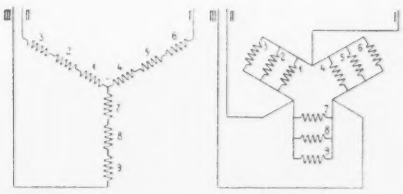
motors is used alone. To give the lowest or third speed, the two motors are coupled in series. It has been found a difficult matter to properly connect two high-ten-



SHOWING THE CONSTRUCTION OF THE WATER RHEOSTAT FOR THE THREE-PHASE LOCOMOTIVE.

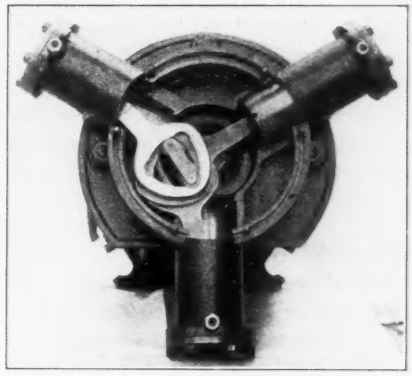
sion, three-phase motors in series, such as stator-rotor, rotor-stator, seeing that the high-tension portion of each motor must be worked upon a resistance. In order to overcome the difficulty, M. Kalomon von Kando devised a method of coupling such

ent method of coupling will be seen in the accompanying diagrams, taking the case of the twelve-pole motor. For each phase the stator is provided with three separate windings. Thus there are nine different windings for the entire motor, and the nine ends of the windings are brought out to the coupling device. The first diagram shows the method of connecting when the motor is used directly upon the line voltage of 3,000 volts. In this case the three coils of each phase are connected in series, and the whole of the three phases is coupled according to the star system. The same method applies for the eight-pole motor. On the other hand, when the



COIL GROUPING FOR 30,000 VOLTS. CASCADE GROUPING.

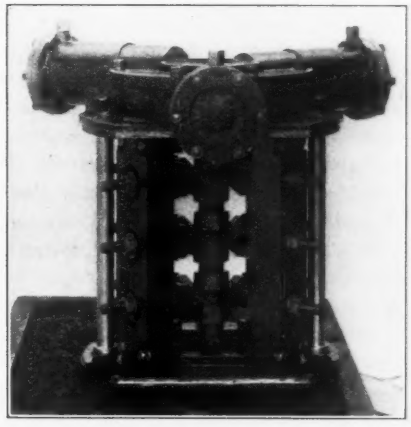
two motors are operated in series to give the lowest speed, the three coils of each phase are connected in parallel by means



TOP-VIEW, SPEED-CHANGING SWITCH.

of the coupling device, and the combination is coupled upon the delta system.

The Ganz firm has built four locomo-



FRONT VIEW, SPEED-CHANGING SWITCH.

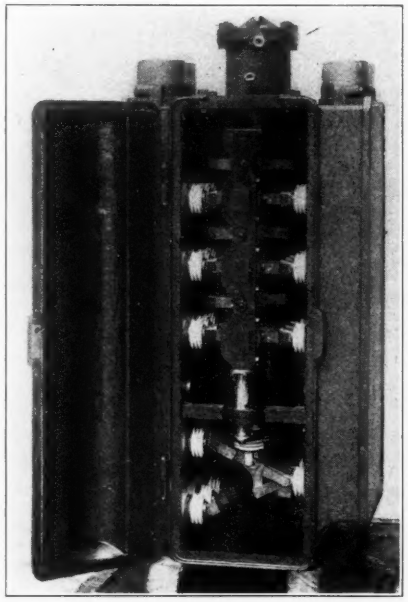
tives of the above type for the Italian railroads. The speeds corresponding to the above-mentioned method of coupling the motors are forty, twenty-five and fifteen miles an hour. It is found that the starting of the locomotive can be

carried out to the best advantage with the new locomotives. On the tests which were made to this effect, no less than thirty successive starts could be made with full load within two minutes time, which is a remarkable performance. The use of three speeds does not prevent the regulation of the power absorbed in the locomotive in proportion to the load which is carried, and the grade, but this is in fact carried out with the best efficiency. There is less energy lost in the resistances, and the latter can be made smaller in proportion to the current which is used.

The new locomotive has about the same power as the former type, this being 3.85 tons normal tractive effort, and at the slowest speed it gives 6.6 tons. According to the conditions of the tests, the locomotives were worked at this rate for a period of ten hours, and the rise of temperature was not above sixty degrees centigrade. However, the engineers wished to work the motors at a heavier load in order to obtain data for future work. Thus the eight-pole motor was given a one-hour test, and it furnished as high as 1,500 horse-power with a rise of temperature of seventy-five degrees. Under the same conditions the twelve-pole motor furnished 1,200 horse-power. The weight of the eight-pole motor is 14.7 tons, while the twelve-pole motor weighs 13.6 tons.

A new device which has been designed specially for the present type of locomotive is the motor-coupling switch. It is shown in one of the engravings, and consists of a cast-iron box provided with a hinged cover. At the upper end is mounted a piston which works by compressed air and drives the central shaft up and down so as to give the switching movement. On the sides of the box are mounted sets of contacts which are coupled to the primary switch and the speed-switch. The corresponding sets of brushes which are mounted on the shaft are made to produce the desired coupling of the motors under the vertical movement of the shaft. The method of mounting the contacts on the side of the box by means of a special type of porcelain insulator gives a solid support as well as a good insulation, as has been found in practice. The inside of the cast-iron box is covered with micanite sheet to give an additional protection.

The apparatus which is known as the "speed switch" is also illustrated in two views, one of which shows the top part of the device and the compressed-air cylinders. The switch is used for connecting the motors and the water resistance for each of the three speeds of the locomotive, and it is accordingly provided with three sets of contact points. The fixed contacts are held in three vertical cast-iron uprights of rectangular section. In the centre is a shaft which can be rotated by means of the compressed-air cylinders so as to secure the three positions of switching. On the shaft are mounted three sets of contact pieces which engage with the fixed contacts in turn. As will be seen in the top view of the device, the shaft is rotated through 120 degrees at each movement by means of three separate compressed-air cylinders which are spaced accordingly. Each piston of the cylinders



Motor-Changing Switch.

carries a cam, and the three cams are superposed and connected with the top of the shaft so as to rotate the latter in the proper way.

The water resistance which is used on the present locomotive is also illustrated in its general appearance and also in different sectional views. It is of especially solid construction. As usual, the apparatus consists of a number of parallel plates, and the water is made to rise between them in order to regulate the resistance for the motors, by means of hydraulic pressure. At the top of the apparatus will be noticed a special arrangement which consists of a choke-coil with variable magnetic circuit. This is also shown on the left of the view of the general connections of the locomotive. The choke-coil is used to vary the current according to the needs of operating. A short-circuiting switch is also provided in order to cut the water resistance out of circuit. Referring to the sectional view of the water resistance it will be noted that the cooling is carried out by means of vertical tubes. These are placed in the spaces which lie on either side of the middle plates. The use of vertical tubes is one point in which the present device differs from the preceding ones. It is found that on account of the heavy loads which are carried in the present type of locomotive a more efficient cooling method is needed and the present arrangement answers very well under these conditions. The outside of the box is provided with cooling wings which are cast with it.

In one of the diagrams will be observed the general connections for the various parts of the locomotive, these being somewhat different from the preceding type. Referring to the letters, *a* indicates the trolley wires; *b*, the trolley; *c*, trolley switch; *d*, main fuses; *e*, choke-coil; *f*, section box; *g*, lightning arrester; *h*, transformer fuses; *i*, shunt for ammeter; *j*, ammeters; *k*, primary switch; *l*, controller for the twelve-pole motor; *m*, speed switch; *n*, eight-pole motor; *o*, twelve-pole motor; *p*, short-circuiting switch for water resistance; *q*, regulator for same; *r*, water resistance; *s*, transformer; *t*, hand controller for air pump; *u*, automatic air-pressure regulator; *v*, air-pump motor; *z*, resistance for voltmeter, *x*, voltmeter.

Merchants' Rate from the Territory of the Central Passenger Association.

On July 25 to 29, inclusive, and again on August 15 to August 19, inclusive, merchants' rates will be in effect to New York city from the territory of the Central Passenger Association. The special rate will be a fare and one-half for the round trip, granted under the certificate plan. The return limit will be thirty days.

The Central Passenger Association railroads traverse territory roughly described as follows: Points west of, but not including, Buffalo, Niagara Falls, Suspension Bridge and Salamanca, N. Y.; Pittsburg and Allegheny, Pa.; Bellaire and Marietta, Ohio; Wheeling, Charleston and Huntington, W. Va., and points on and north of the Ohio River and east of the Mississippi River, and south of a line from Keokuk, Iowa, to Chicago, Ill., including Cincinnati, Louisville, all towns in Kentucky on the Chesapeake & Ohio Railway, St. Louis, Keokuk, Chicago, southern peninsula of Michigan, and Canadian towns on the Michigan Central Railroad and Wabash Railroad.

SWITCHGEAR-CONTROL APPARATUS AND RELAYS FOR ALTERNATING-CURRENT CIRCUITS.[1]

BY CHARLES C. GARRARD.

The installation of control relays on high-tension alternating-current circuits has become standard practice, and is likely so to continue. The correct design and layout of such relays is of the highest importance. On their proper action a large part of the success of the system depends. Recognizing this, it is somewhat remarkable that many systems are in operation to-day designed on wholly erroneous lines. This is due, no doubt, in part to the fact that the relay control apparatus has not been deemed worthy of great attention in comparison with, say, the performance of the generators and prime movers. Another reason is that of apparent economy. The object of this paper is, first, to deal with a number of such instances which have come under my notice, and, secondly, to examine some other systems of control working at present in use or proposed to be put into application.

Polyphase Maximum Time Element Relays—A considerable number of such relays have been installed in various supply stations. They consist of a polyphase-wound relay having a single moving element which moves under the action of the currents in two or three of the phases. We will consider such a relay in use on a three-phase, four-wire circuit, in which case it would have three windings energized by each of the three phases. Let us suppose it to be set to operate after, say, thirty seconds continued overload at 150 per cent of full load. This means that after 150 per cent of full load has flowed in each phase for thirty seconds the relay operates. It is obvious, of course, that each phase contributes under these conditions one-third of the operating torque in the relay. If T be the operating torque, we may set—

$$T = K\left(\frac{3}{2}c_1 + \frac{3}{2}c_2 + \frac{3}{2}c_3\right),$$

where K is a constant and $c_1 = c_2 = c_3 = c$ = full-load phase current. Suppose now that instead of the overload occurring on each of the three phases simultaneously, it only took place in one phase, as is quite possible on a four-wire system, due to the breakdown of one phase to earthed neutral. It is clear that in order to operate the relay the overload on the single overloaded phase must be much greater than before. If the current flowing in the other two phases be the normal full-load current, we get—

$$K(C_1 + c_2 + c_3) = \frac{3}{2}K(c_1 + c_2 + c_3)$$

$$\therefore C_1 = \frac{5}{2}c.$$

This is to say, the current in the single overloaded phase will have to rise to two and one-half times the normal full-load current before the relay will operate. Of course, these equations are only illustrative, as the law connecting operating torque and current in a relay is generally more complex than a simple proportion. They, however, illustrate the undoubted fact that with polyphase maximum relays very large and dangerous overloads can continue to flow in any one phase without causing the relay to operate and to open the circuit. Polyphase relays should never be used, but always single-phase relays connected entirely separately on two or three of the phases on three or four-wire systems, respectively.

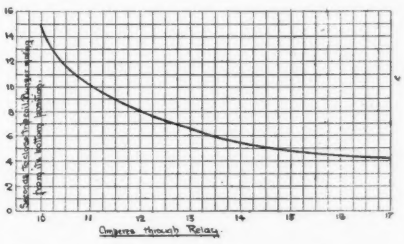


FIG. 1.—CALIBRATION CURVE OF SOLENOID RELAY.

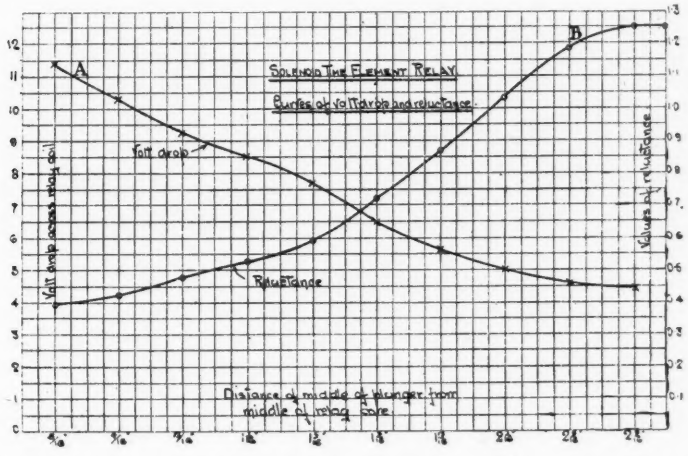


FIG. 2.—CURVES SHOWING VARIATION IN RELUCTANCE AND CHANGE IN POTENTIAL DROP ACROSS A SOLENOID RELAY AS THE AIR-GAP CHANGES.

Polyphase Reverse Relays—Exactly the same objection applies to the use of these as to the use of polyphase maximum relays. If, for example, the reverse relay be set for fifteen per cent reversal on any one phase, it is clear that if the reversal occurs on all three phases at once—as, for example, when a bad attempt at synchronizing is made—a reversal of five per cent is sufficient to operate the relay, which would be too delicate a setting for the case in question. On the other hand, if a reversal of fifteen per cent in all phases at once is required to operate the relay, a very large reversal in any one phase can take place before the circuit be open-circuited. In fact, under some conditions with a reversal in one phase only the tendency toward operation in the relay due to this reversal is neutralized by the increased forces in the opposite direction due to the unreversed phases, and the relay quite fails in its action. The only perfect solution is to install a separate single-phase relay on each phase, either two or three, as the case may be.

Solenoid Relays—A considerable number of maximum time-limit relays, operating on the solenoid principle, are in use at the present moment. They consist of a solenoid having a movable iron plunger which is sucked up when the current in the solenoid exceeds a certain value. The iron plunger is attached to a dashpot or air-bellows which retards the travel of the plunger, the amount of the retardation being varied by means of a small valve which controls the clearance in the dashpot, or the rate at which air can pass in or out of the bellows, etc. Thus the plunger is caused to take a certain time to travel to its top position. When the top position is reached contact is made in the trip-coil circuit and the controlled circuit is opened. A typical relay, made by a well-known firm, operating upon this principle was experimented upon, and its calibration curve is shown in Fig. 1. The coil in this relay consists of about 325 turns of wire. Some measurements made

[1] A paper read before the Institution of Electrical Engineers of Great Britain, May 14.

on this instrument are represented in Fig. 2. The current through the coil was maintained constant at ten amperes, fifty cycles per second, and while the position of the plunger in the solenoid was varied the volt-drop across the terminals of the coil was measured. It will be noted that as the plunger is raised within the solenoid the volt-drop across the same is increased largely, and, of course, the volt-ampere consumption of the relay goes up. From these measurements and the known ohmic resistance of the coil it is possible to calculate the coefficient of self-induction in henrys L, and from this, and the number of turns S, the magnetic reluctance of the circuit can be calculated from the formula

$$\text{Reluctance} = \frac{4\pi S^2}{10^9 L}.$$

The variation of the magnetic reluctance of the relay with alteration of the position of the plunger is given in curve B of Fig. 2. As the plunger goes up the magnetic reluctance goes down. Now, with a constant magnetizing force in the relay the attractive force on the plunger varies inversely as the square of the reluctance. It follows that if, due to the passage of a certain current through the relay, the plunger is caused to travel upward, the higher the plunger goes the less the current necessary to keep it in its new position. Thus the current in the controlled circuit can fall again to its normal value, but the plunger will not fall, but remain "floating" for an indefinitely long period near its top position. If, now, the current again increases, the plunger will complete its upward journey, but without any time element whatever, this being due to the fact that the first small movement in a dashpot is unretarded, no matter from what position in its travel the plunger starts.

Experiments made to test this theory confirmed it in every particular. It was found that if the plunger was allowed to travel upward, due to the passage of an excess current, and the current was reduced to its full-load value before contact had been made in the trip-coil circuit, the plunger did not fall, but remained floating near its top position. The next time the overload came on the relay closed the trip-coil circuit without any time element whatever. This test is in exact parallel with actual practical conditions. The figures of an actual test are as follows: The relay was adjusted so that contact was made between the trip contacts when nine amperes (that is, the starting current) flowed through the winding. On reducing the current, however, the plunger did not at once fall. At seven and one-half amperes the trip circuit was just broken, but not until 5.2 amperes was reached did the plunger fall back to its bottom position. Now, 5.2 amperes in the relay would correspond to about full-load current in the primary circuit. Translated into practical conditions, these results mean as follows: At time of full load a short comes on the system which is intermittent in nature. The current increases sufficiently to pull the plunger of the solenoid relay, but not for a sufficient time to close the trip contacts. The short

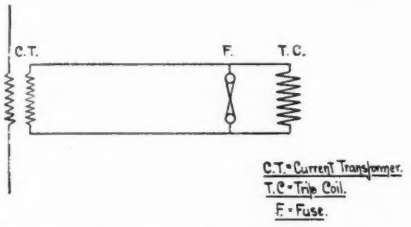


FIG. 3.—CIRCUIT-BREAKER SHUNTED WITH FUSE FOR TIME-ELEMENT CHARACTERISTIC.

goes off, but the full load remains flowing in the circuit. Consequently the plunger does not fall, but remains floating near its top position, and the next time the short comes on the relay operates without any time element whatever, and the whole object of the apparatus is vitiated. These results show pretty conclusively that the dashpot solenoid type of maximum relay is not to be relied upon for dealing with intermittent overloads or shorts.

Fuse-Shunted Trip-Coils—A method sometimes adopted to impart a time element characteristic to an ordinary circuit-breaker is to shunt the trip-coil with a

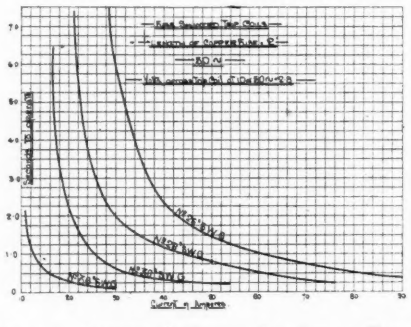


FIG. 4.—CURVES SHOWING CHANGE IN TIME ELEMENT WITH THICKNESS OF COPPER FUSE.

fuse (Fig. 3). Normally the secondary current of the current transformer flows through the fuse and not through the trip-coil, until the fuse blows and the current is diverted through the coil. The time taken for the fuse to blow gives the time element. It is only possible to use this scheme for alternating currents, as with continuous currents the whole of the current passes through the trip-coil, and a sufficient volt-drop to blow the fuse can not be obtained. The chief advantage of this scheme is cheapness. Its efficiency may be judged from the following considerations. The two essential functions of a time-element device are as follows:

(1) The time lag should prevent the circuit-breaker opening with every momentarily abnormal rush of current.

(2) A discriminating action should be obtainable—that is, if two time-element circuit-breakers are in series it should be possible to adjust one to open before the other.

The second function is vital in all important circuits. As an example, consider a high-tension feeder going to a substation in which motor-generators are working. Maximum time-element circuit-breakers would be installed in the generating station on the outgoing feeders, and also in the substation between the bus-bars and the motors. In the event of a dangerous overload on a machine it is necessary that its circuit-breaker should operate before that installed on the feeder at the generating station. If this happens the faulty machine is cut out satisfactorily and a disturbance of the supply does not result. The point to be ascertained is how far this discriminating action can be attained. The following experiments were made to elucidate this:

The trip-coil used was a standard ten-ampere one, having a volt-drop of 2.8 volts at fifty cycles, the plunger being set so that it was pulled up with ten amperes through the coil. In order to approximate to working conditions, the current through the coil and fuse in parallel was kept constant at eight amperes and then suddenly increased by definite amounts, and the time noted which elapsed before the trip-coil operated. The curves (Fig. 4) give the results obtained by varying the thickness of the copper fuse wire. It will be seen that altering the thickness of the wire not only alters the current at which the combination works, but also affects the time element enormously. Thus independent adjustments of the time and the current calibrations are not feasible—at least, if fuse wires of constant length and of the same material are used.

The resistance of two inches of No. 30 standard wire gauge copper wire is 0.011 ohm at sixty degrees Fahrenheit.

As the impedance of the trip-coil is 0.28 ohm, it will be seen that practically all the current flows through the fuse. It follows that regulation of the

current at which the arrangement works can only be effected by altering the fuse wire, and simply raising or lowering the plunger in the solenoid will have no effect.

A characteristic of all the curves of Fig. 4 is that on large overloads the times taken all become practically zero. That is to say, on heavy overloads any time discrimination disappears altogether.

It might be urged that as putting in a thicker wire both increases the time element and also the current at which the combination works, a solution of the problem may be obtained. It must be remembered, however, that the current through the fuse is the secondary current of a current transformer, and, although the primary current in the generating station may be larger than the primary current in the substation, yet, the secondary currents are generally equal, the ratios of the current transformers being varied according to the values of the primary current. For important distributions, therefore, the fuse-shunted trip-coil is not suitable. It may, however, find useful application on motor-control panels where ordinary fuses are not desired, and where a discriminating action apart from the prevention of the machine being cut off to every temporary overload is not wanted.

(*a*) THREE-PHASE, THREE-WIRE SYSTEMS.

For three-phase, three-wire systems two separate single-pole relays are theoretically necessary to afford complete protection. When what may be designated the "resultant" scheme of connections has been used a single-phase relay only has been installed, but in conjunction with two current transformers, so connected that the current in the relay is the vectorial resultant of the current in each of the phases in which the current transformers are situated (Fig. 5). A superficial examination would lead one to think that as the relay current is the resultant of the currents in the two phases, an overload in either will cause the relay to operate and thus afford complete protection. A number of supply stations in England have protective apparatus installed in this manner. On working out the currents in the relay vectorially, however, it will be found that the protection afforded by this method is doubtful. We will assume the normal full-load secondary current of the transformers to be ten amperes, and that the relay is set to operate at 200 per cent of full-load current; that is, it will operate when 34.6 amperes flow through it. If now the overload occur on both the phases connected to the relay, and the phase displacement in each phase is the same, then the circuit is opened when twenty amperes secondary current flows in each phase. It is quite likely, however, that the overload will only occur in one of the phases, and in this case the phase displacement will most probably not be the same in each phase. If the angle of lag in each phase is equal, and only one of them is overloaded, it will require 282 per cent full-load current in the single overloaded phase to cause operation. Should, however, the current in the overloaded phase lag sixty per cent more than the other phase, which is quite possible, then the current in the overloaded phase would have to increase to 386 per cent of full-load current before the circuit is broken. That is to say, with this scheme of connections and the circuit-breaker set so that it comes out with the ordinary test at 100 per cent overload, one of the phases, and of course the unprotected phase, could be overloaded to the extent of 200 or 300 per cent without the circuit being opened. It will be agreed that such a scheme of protection is somewhat illusory.

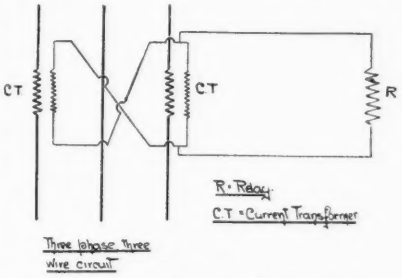


FIG. 5.—FAULTY RELAY CONNECTIONS ON THREE-PHASE, THREE-WIRE CIRCUIT.

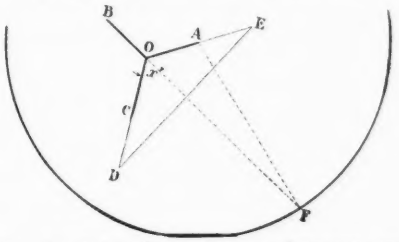


FIG. 6.—CLOCK DIAGRAM FOR SHOWING THE POSSIBLE OVERLOADING WHEN THREE-PHASE RELAYS ARE USED.

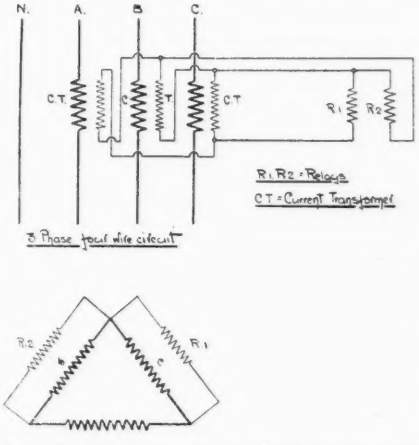


FIG. 7.—FAULTY RELAY CONNECTIONS ON THREE-PHASE, FOUR-WIRE CIRCUIT.

The figures given above can be obtained from a simple clock diagram (Fig. 6). The three full-load normal currents are O A, O B, and O C. If O E = 2 O A, then E D = the current through the relay which causes it to operate. If a circle with radius = D E be struck from A as centre, then the current flowing in the phase O C for any particular angle of lag x is O F, it being supposed that the current O A remains constant. The two current transformers are, of course, in phases O A and O C.

(*b*) THREE-PHASE, FOUR-WIRE SYSTEMS.

The three-phase, four-wire system is shown in Fig. 7. It will be seen that three current transformers are necessary, but only two relays are used, the idea being to save the cost of the third relay. At first sight it would seem that, as

Current in R_1 = current in c + current in a,

and Current in R_2 = current in b + current in a,

there could not be an abnormal current in any one of the three current transformers without there being a corresponding current in R_1 or R_2.

Exactly the same consideration, however, can be applied to this case as in section (*a*), as it is quite possible for one phase to be overloaded since it has a return path through the fourth wire. If this overload has a large phase displacement relative to the currents in the other phases, then the condition may arise of very big overloads in the one phase and the circuit-breaker not operating.

The only safe arrangement is to have the same number of relays as current transformers. If the circuit be a four-wire one, then three relays are necessary; if three-wire, then only two relays are essential.

Alternating-Current Reverse-Power Relays—Such relays are installed between bus-bars and sources of electrical energy; thus they are used for controlling generator switches and the switches at the far ends of feeders. In such positions complete protection is afforded by the reverse relay, and the installation, in addition, of maximum-current circuit-breaking apparatus at the same places must be regarded as bad practice. The requirements to be met on generator circuits and on

the ends of feeders are, however, different, and also vary with the type of prime mover.

Reverse Relays on Generators—These should only come into operation when a serious fault has developed on the generator or prime mover of the nature of an insulation breakdown in the winding, or a total failure of steam power. A short consideration will show several cases of accident to the prime mover, in which an automatic disconnection from the bus-bars would only be an aggravation of the trouble. For example, consider two or three large compound Corliss engines, with three-phase generators running in parallel. A not uncommon fault is the failure of one of the admission valves to open, with the result that steam is admitted to only one side of the piston. Under these circumstances a large surging current passes backward and forward from the faulty to the good machines. This is due to the very uneven turning moment in the engine caused by the unequal distribution of steam in the cylinders. The wattmeter and ammeter needles are set into a violent state of oscillation, but the generator remains in step. The fault with the valve is but a small matter, and is noticed at once by the driver, who attends to it immediately, the surging current ceases, and everything goes on as before. If, however, this set had been cut off the bus-bars, the other generators would have become seriously overloaded, with probable variation in volts, and all the trouble of synchronizing would have had to be gone through. A satisfactory generator reverse relay should withstand therefore, without operating, such a surging of power from one machine to the other, provided the two remain in synchronism. These surges into the faulty set are, of course, reversals, and, moreover, of considerable magnitude.

From this instance it follows clearly that a generator relay which operates instantaneously on a reversal is not desirable. In fact, it can not, under the above set forth circumstances, be used at all.

Failure of Field Current of Generator—With the diminution or total failure of the field current of a generator, the current in the windings increases greatly and leads considerably on the machine volts. Provided the set remains in synchronism, and the steam supply is in order, the alternator continues to supply energy to the system, and there is no reason why it should be disconnected from the bus-bars. The large increase of current is noticed by the switchman, who immediately seeks for and remedies the fault without any serious disturbance of the supply. If, when the field circuit fails, the set drops out of step, then it should rightly be disconnected, but this would generally follow, as, with the set out of step, a large flow of power into the machine from the bus-bars would most probably take place.

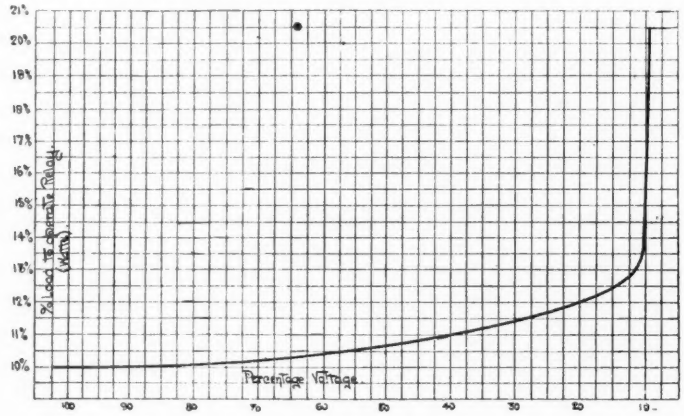


FIG. 8.—ALTERNATING-CURRENT REVERSE RELAY. VARIATION OF CALIBRATION WITH VOLTAGE.

Effect of Reduction of Bus-bar Voltage on Generator Reverse Relays—It will be understood that any form of relay, one of whose constituent parts is a shunt coil, will be affected by variation in the voltage applied to the same. The shunt coil of the generator reverse relay is excited (through the intermediary of potential transformers) directly from the bus-bars. On the occasion of an accident to one of the generators the bus-bar volts will tend to go down. The trouble is intensified by the fact that, as has been shown, an instantaneous relay can not be used, therefore there is more time for the voltage to fall. It must be remembered, however, that a failing generator in parallel with one or more good ones is not likely to pull the volts down to any very alarming extent. Probably a fifty-per cent reduction is the maximum to be expected. It is clear, however, that the calibration of the relay should be as little affected by variation in the bus-bar voltage as possible. Curve Fig. 8 shows the effect of reduction of the shunt voltage on the calibration of a reverse-power relay, consisting of a specially designed wattmeter movement. It will be seen that the calibration is practically unaffected down to ten per cent of the normal voltage. The limit down to which it works is seven or eight per cent, below that it becomes inoperative. The relay is also absolutely inoperative on forward power under all conditions. Tests made up to ten times full-load current in the forward direction proved this.

Setting of Reverse Relay on Generators—The most suitable value to which a generator reverse relay should be set is such that it will operate, after the requisite time element, with an energy reversal of ten per cent of the full rating of the machine. With this setting the current which can flow in the generator windings is never very excessive. It has been suggested that ten per cent is too fine. A case which came under my notice was that of some triple-expansion three-crank engines, driving 6,600-volt, three-phase generators. These engines were fitted with emergency stop valves. Owing to the method adopted for operating these valves they would occasionally close accidentally and shut off the steam. Under these conditions the energy reversal would exceed ten per cent, and therefore a twenty-five per cent setting was asked for, so that the machine should not be cut out of circuit, but remain in step, allowing the driver time to open the valve again. The proper cure for the trouble would be, however, to arrange the emergency valve so that it did not operate in this manner.

(To be concluded.)

Reunion of Thomson-Houston Employes.

George Cutter, of the George Cutter Company, South Bend, Ind., announces that the reunion of Thomson-Houston employés bids fair to become quite an important event, as many men prominent in the electrical business have expressed a desire to participate. Reports indicate that a large gathering will meet in Chicago at the electrical show next January for this reunion of Thomson-Houston veterans.

Public Service Commission Bill Killed.

On June 11 Senator Page's bill extending the jurisdiction of the Public Service Commissions of New York state to telegraph and telephone companies was lost upon a motion to discharge the Senate committee having the bill in hand from the further consideration of the bill.

POWER DEVELOPMENT IN SMALL STATIONS.[1]

BY CHARLES ROBBINS AND J. R. BIBBINS.

The opportunity for the sale of power is large in any manufacturing community, and there is also a considerable demand even where manufacturing is not highly developed. This latter demand comes from department stores, hotels, restaurants, small machine and repair shops, power buildings renting space to small manufacturing enterprises, printing houses, garages, apartment houses, residences, and so on.

In developing a power load, one of the first problems that confronts the central station management is, how to make rates that will encourage power business and still yield a profit.

The question of power rates is, and perhaps always will remain, a complex one. The subject has been thoroughly discussed at previous meetings, and it is not our intention to here advance suggestions as to what the power rate should be, but rather to show the influence of long-hour service as a factor in decreasing cost per kilowatt per hour.

[1] Abstract of a paper read before the National Electric Light Association, Chicago, Ill., May 19.

The cost of a unit of power comprises two distinct and dissimilar charges: First, that termed the fixed or investment cost, and, second, that represented by the operating expense or variable cost. The fixed charges comprise bond interest, taxes and insurance, depreciation or sinking fund and apportioned executive charges. These continue whether the plant is working or idle; operating charges, comprising fuel, wages, supplies and repairs, vary with the running or operating conditions, or in more concrete terms, with the load-factor. Combined, these two charges create a condition in which the relative total cost of power generated is very seriously dependent upon the output or load-factor.

By way of illustration, the curve shown in Fig. 1 was prepared from data obtained in the operation of one of the largest and most efficient power stations in Great Britain—the 20,000-kilowatt station at Newcastle-on-Tyne. This station is entirely equipped with turbine machinery of the Parsons type, and holds the record in British territory for lowest total power cost—largely through effective power-load development. This curve shows the variation in station efficiency, and, therefore, the increase or decrease in cost per kilowatt-hour with different load-factors, and is plotted on the basis of power delivered to customers—that is, the income of the station. It, therefore, takes into account line and transformer and meter losses. This curve shows clearly that as the load on the station approaches the generating capacity, the cost per unit decreases. This, of course, follows from the fact that the efficiency of the generating apparatus continues to improve up to about full rating. But, even more important, an increase in the hours of heavy-load service, which has a direct bearing on the interest and depreciation charge, tends to decrease the cost of fixed charges per kilowatt-hour, as is very effectively shown in Fig. 9, discussed later.

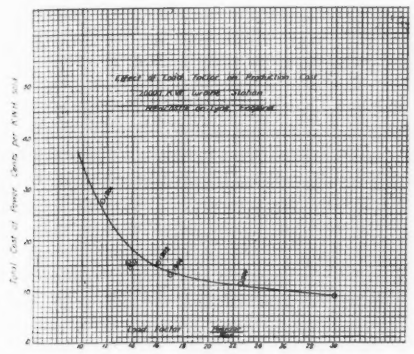


FIG. 1.—EFFECT OF LOAD-FACTOR ON COST OF PRODUCTION, 20,000-KILOWATT TURBINE STATION, NEWCASTLE-ON-TYNE, ENGLAND.

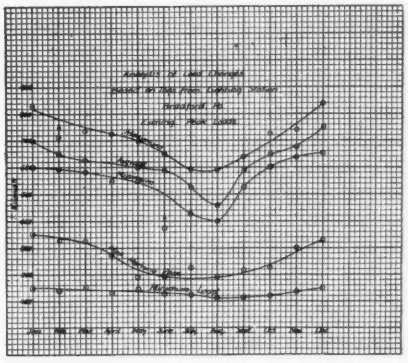


FIG. 2.—ANALYSIS OF LOAD CHANGES BASED ON LOGS FROM LIGHTING STATION—EVENING PEAK LOADS—BRADFORD, PA.

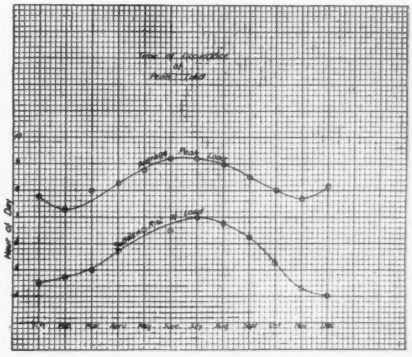


FIG. 3.—TIME OF OCCURRENCE OF PEAK LOAD.

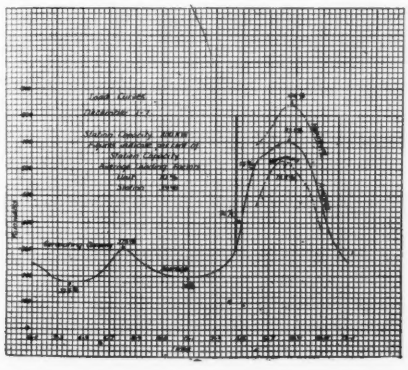


FIG. 4.—LOAD CURVES, 800-KILOWATT STATION, DECEMBER 1-7.

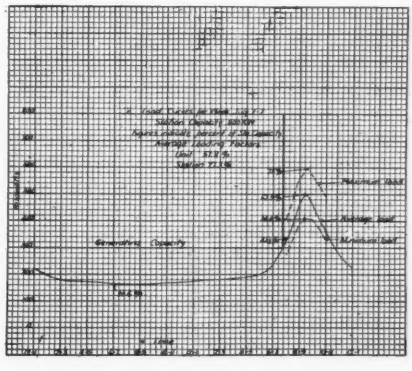


FIG. 5.—LOAD CURVES, 800-KILOWATT STATION, JULY 1-7.

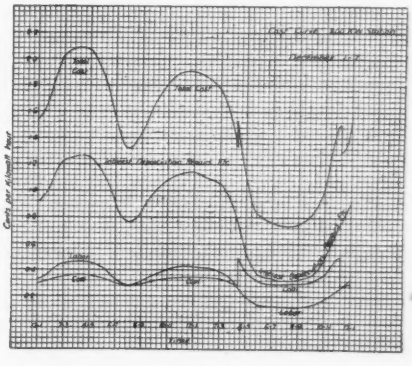


FIG. 6.—COST CURVES, 800-KILOWATT STATION, DECEMBER 1-7.

To obtain a true idea of the cost of power in a central generating plant it is not sufficient to examine the average cost over a considerable period of changing loading; there should also be available two distinct sets of data, each reduced to the form of representative curves. (a) The hourly cost of fixed charges; (b) the hourly cost of operating expenses. From this information a composite curve may be drawn showing the cost for any hour of the day or night of each kilowatt gener-

ated at 100 per cent loading-factor. But, as commercial conditions are such that a 100 per cent loading-factor is in most stations unattainable, it is necessary to provide data showing the cost per hour of each kilowatt generated at various station load-factors.

Analysis of Curves—The importance of these data is well illustrated in the accompanying cost curves, which represent the results of a study of a typical case based on actual load curves for an existing lighting station. The case will serve as an example of the method pursued in similar studies. Table I shows the data on which the cost curves were based, and it must be understood that these data are of a purely relative nature—to exemplify a principle rather than to establish specific facts.

The proposed station will be within the 1,000-kilowatt class, and, as such, representative of a great majority of stations serving the smaller cities of the country. Equipped with steam turbines, its operation will be characterized by fairly high economy even at the load-factors usually occurring in lighting systems of such limited scope.

Through the courtesy of J. H. Rose, manager of the Bradford (Pa.) Electric Light Company, we are permitted to place before you some actual curves from a lighting system similar in extent and character to that under discussion. Although gas-engine motive power is at present used in this station, due to the liberal supply of natural gas, the load characteristics are typical and may be used as a direct basis for our computation. The Bradford system is largely 1,100-volt, alternating-current lighting with direct-current series arcs on moonlight schedule. Power load is incidental, and, as may be seen from the curves, a large opportunity exists for day power load.

In order to best study the load changes throughout the year, load curves were plotted for the first seven days of each month. These showed a fairly consistent change with the seasons, as expected. Fig. 2 shows a change in the time that peak loads occur during the various seasons, and Fig. 3 the gradual shifting of the evening peak as summer approaches. Here the sudden rise in load occurs about two hours before the evening peak is reached.

Reverting to Fig. 2, it will suffice to examine two typical periods, summer and winter, giving the extreme conditions arising in the operation of the plant. Fig. 4 and Fig. 5 depict the average weekly load for December and July with the maximum and minimum peaks for the seven-day period shown by dotted lines. Note the entire absence of morning peak in the summer, also the steeper rise and flatter evening peaks in the winter.

We may now proceed with our projected plant, using these load curves as a basis. While it would be entirely possible to handle this load efficiently with a greater number of units, as is actually the case at Bradford, we have assigned but two units, relying upon the high light load economy of the steam turbine to compensate for the operating and other disadvantages resulting from a further subdivision of generating capacity. Taking, then, these actual load curves, we may obtain the per cent loading of both the generating units and the station by integrating the areas lying beneath the respective curves. Thus, during December the station generated thirty-nine per cent of the possible capacity, and during July but twenty-seven per cent. Similarly, during December the average turbine load in rating was as high as seventy per cent, during July but fifty-eight per cent. By operating three smaller units instead of the two sizes chosen, these percentages might undoubtedly be improved, but not to any great extent, at least hardly sufficient to compensate for the higher installation cost and the complexity of operation.

Here is the starting point of our real subject: How best may we increase the average load on the generating plant above this low figure of fifty-eight to seventy per cent of rating? The problem may first be approached by determining the variation in efficiency and cost of power during various periods of the day—in fact, for each successive hour. Knowing the per cent of rating at which each unit is working, the water rate corresponding to this load may be found from the steam-consumption curve of the machine, available from tests. Again, assuming proper boiler-plant operation, the coal-consumption rate may be estimated within reasonable limits of accuracy, or, better still, from actual tests on the boiler plant, making due allowance for standby losses of idle boilers. With a given price of coal, the cost of fuel per kilowatt output of the station thus becomes a widely varying quantity, decreasing as the average unit load increases. This variation will, of course, become smaller as the efficiency of all

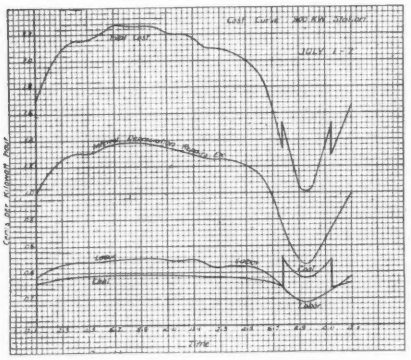


FIG. 7.—COST CURVE, 800-KILOWATT STATION, JULY 1–7.

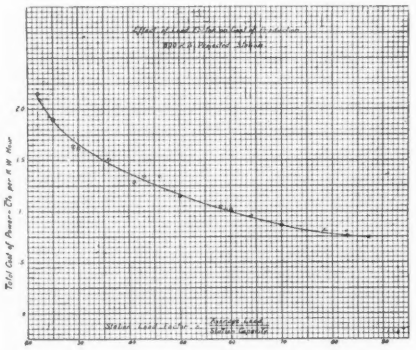


FIG. 8.—EFFECT OF LOAD-FACTOR ON COST PRODUCTION, 800-KILOWATT PROJECTED STATION.

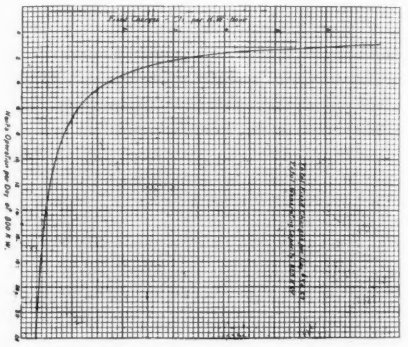


FIG. 9.—TOTAL FIXED CHARGES PER DAY, $54.57; TOTAL GENERATING CAPACITY, 800 KILOWATTS.

TABLE I

DATA SHEET FOR CURVES

Lighting station, rated capacity	800 kilowatts
Lighting station, overload capacity 50 per cent	1200 kilowatts
Number turbine units, two	1 300-kw 1 500-kw
Maximum peak loads	600 to 800 kilowatts
Boilers (one spare)	3 350-hp
Coal—bituminous run-of-mine, 13,500 B.t.u., hand-firing, natural draft	$2.25 per ton
Condenser, surface type	27.5 inch vacuum
(Condensed steam returned to boilers.)	
Steam consumption (dry saturated, full load)	20 pounds per kilowatt-hour
Evaporation (full load) pounds water per pound coal	7 pounds
Coal consumption (full load)	2.86 pounds per kilowatt-hour
No extra allowance for banking fires.	
No charge for cost of make-up water	
Cost of station complete, $166 per kw.	$132,800
Labor and supplies (12-hour shifts) per year	7,300
Fixed charges per year	19,920
Interest, 5 per cent; taxes, 1.5 per cent; running repairs, 1.5 per cent; sinking fund (15-year life) and executive, 7 per cent	15 per cent.
Depreciation here considered as sinking fund, based on 15-year life = 6.66 per cent depreciation fund at 5 per cent interest, total depreciation and repairs, 8 per cent	

parts of the power plant increases—boilers, turbines, auxiliary and electric apparatus—especially at light loads.

Refer now to Fig. 6 and Fig. 7, in which the station cost per kilowatt output is plotted for each hour of the day and segregated into the principal factors grouped as follows: (a) Fuel, (b) labor and supplies, (c) fixed charges and repairs. Items (a) and (b) form together with running repairs what are usually known as operating or station costs. Item (c) includes all capital charges, such as interest, taxes and insurance (if carried), depreciation (or sinking fund for replacement of the plant at the end of the term of years), and such a proportion of executive charges as may be assigned to the power department. For simplicity, repairs are here considered as fixed charges, to permit spreading over the term of years as an average rather than as a variable quantity increasing annually, hence, the proportion of fixed costs is, in these diagrams, somewhat larger than is usual in the average power plant.

These curves might, perhaps, have been more readily apparent by plotting for each hour of the day the actual cost in dollars for various operating and fixed charges. While the fuel item would have practically followed the load curve, the remaining items would naturally be regarded as constant charges. Hence, it follows that the total expense would also have followed the load curve.

But it is the cost per kilowatt-hour generated, rather than the actual outlay, with which we have to deal, and upon which any analysis of power-station operation depends. Referring to Fig. 6, the coal curve shows an abrupt change at 4.30 P. M., which is, of course, due to the starting of the second unit, and is accompanied by a reduction in the unit loading-factor. Outside of these changes, however, the coal cost is fairly uniform. Labor, on the other hand, varies inversely with the station loading-factor, and hence is highest in the early morning, and lowest during the evening peak. Likewise, fixed charges; but, being practically half of the total expense, the variations are wider. Finally, the curve of total cost shows the combined characteristics and extreme range of fluctuation from 0.75 cent per kilowatt-hour to 2.1 cents per kilowatt-hour for the month of December, and one cent to 2.3 cents per kilowatt-hour for July. Moreover, during the summer months particularly, the general average lies well above the arithmetical average of these two extremes—about 1.5 cents for December and 1.9 cents for July.

These fluctuations represent, then, the actual variation in total cost of power at various periods of the day. It remains to plot these values in the form of Fig. 8 to appreciate their full significance. Here, within the range of an actual day's operation, we have exactly tripled the cost of power production due entirely to the poor day loading.

Obviously, our endeavor to improve this condition could be directed along lines dictated by Fig. 6 and Fig. 7—smoothing out the humps by the addition of limited day load, not increasing them by short-hour peaks. The former loads the existing equipment to better advantage; the latter may actually decrease instead of increase the loading-factor, due to the extra peak capacity required, and hence increase rather than decrease the cost of power.

Having brought out the necessity for analyzing power cost for each hour of the day to obtain a true idea of the relative cost of day and night power, there remains the application of this same method to typical days of the year, to show the proper distribution of fixed costs. In our prospective study, Fig. 6 and Fig. 7, fixed costs have been spread evenly through a 365-day year, and hence are represented as at the minimum. But as the net effect of Sundays and holidays is to largely reduce the station load-factor, these periods should bear the same relation to the entire period as the short-hour to the long-hour customer. Hence, in any study of the cost of limited service, fixed charges should be apportioned in a manner illustrated by Fig. 9 for the particular period under consideration; that is, the annual charge should be distributed over a 305-day year for ten-hour day power.

Railroad Electrification.

An article in a recent issue of the *Wall Street Journal* estimates that there is $100,000,000 worth of railroad electrification under consideration. A representative of one of the leading electrical engineering firms in the United States is quoted as follows:

"We figure that there is $100,000,000 of electrical equipment for steam roads under consideration in this country, including work planned by the New Haven, New York Central, Pennsylvania, Harriman lines and others.

"One of the Eastern trunk lines is planning an expenditure of $35,000,000 in electrification.

"The New Haven Railroad electrification will be extended to New Haven, Ct., and work upon this section will soon be started. Plans are also prepared for electrical installation on the New Haven road between Providence and Boston.

"The New York Central will likewise extend its system running out of New York and has plans in embryo for the electrification of the Boston & Albany out of Boston.

"As between the New York Central and New Haven systems it is claimed that the New Haven is showing the greatest economies in operation, but the New York Central has $2,500,000 tied up in its Yonkers power plant, which it is not using at present and from which it is getting no returns. Its Port Morris power plant is able to furnish the necessary power requirements.

"The electrification of steam roads is fast assuming shape and is unquestionably the next big move in the electrical world."

Chinese Telegraph Lines.

Consul-General James W. Ragsdale, of Tientsin, submits the following information with reference to the Imperial Chinese telegraph lines, gathered from reports recently published:

At the end of 1906 the administration had a system of 22,419 miles of telegraph lines, with 34,473 miles of wires and a submarine cable of 946 miles; 379 offices, of which sixty-two were open for day and night service and 317 for day service only. The number of instruments in actual use was 768. The staff of the head office in Shanghai numbered sixty-seven and the general staff 3,175, while inspectors, linemen, etc., totaled 2,400. In addition there are many provincial lines, usually constructed by the administration, but worked and managed independently by the provincial authorities.

The telegraph companies having connections with China are the Great Northern, Eastern extension, German, Dutch and Commercial Pacific, while the French cable connects Touraine with Amoy, a German cable Shanghai with Kiachow and Chefoo, and a third cable, partly Chinese, Chefoo with Port Arthur. China also has frontier connections with Burma, Indo-China, and Russian Siberia.

Civil Service Examination for Electrical Engineer and Mechanical Draftsman.

The United States Civil Service Commission announces an examination on July 22, 23 and 24 to secure eligibles from which to make certification to fill one or more vacancies in the position of electrical engineer and mechanical draftsman, at an entrance salary of from $100 to $200 per month and upward, in the reclamation service, and vacancies requiring similar qualifications as they may occur. Eligibles from this examination may be appointed as electrical engineers or assistants for the design, installation or operation of hydroelectric and steam power plants in the West, or as mechanical draftsman for office work and drafting in connection with preparation of plans. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1,312. No application will be accepted unless properly executed and filed with the commission at Washington prior to the hour of closing business on July 11. In applying for this examination the exact title "Electrical Engineer and Mechanical Draftsman" should be used.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A New Method of Determining Light-Distribution Curves.

A brief description is given here of a method devised by W. Voege for taking the place of the usual laborious and tedious method of determining the mean spherical candle-power of a lamp. For this purpose a thermopile is substituted for photometric screen and two screens are employed: One of thick glass to cut off the heat rays, and another of thin green glass to reduce the effect of the red rays, since the thermopile is more vigorously affected by these than is the human eye. This thermopile is mounted on an arm which can be rotated about the lamp in a vertical plane, while the latter may be rotated about a vertical axis. The thermopile is attached to a galvanometer for giving deflections which are proportional to the intensity of the light at every instant. The stand of the thermopile has a sight tube for centring it about the lamp. The beam of light coming through this tube is conveniently used for illuminating the reflecting galvanometer. The method of taking readings then consists in rotating the arm about the lamp and observing the deflections, or the instrument may be made self-recording by attaching a dark-box to the stand supporting the thermopile. Within this is a disc attached to the rotating arm, on which bromide paper is placed. A narrow slit in the dark-box allows the spot of light from the galvanometer to fall upon the paper, and as the thermopile is rotated slowly about the lamp, a curve is traced showing the relative intensities of the light at each instant. By integrating this curve the average value is at once obtained.—*Abstracted from the Electrical Review (London), May 29.*

British, American and German Standards for Electrical Apparatus.

A comparison is made here by J. S. Peck between the standardization rules of the American Institute of Electrical Engineers, those published by the German Technical Society, and a preliminary report upon the same subject which has recently been submitted by the Engineering Standards Committee, of Great Britain. The subject is now under consideration in England, and tests are being carried out in the National Physical Laboratory, London, so that probably before long a more complete set of rules will be reported. Comparison of those rules which have already been submitted in England with the other two shows that in England and in the United States a temperature rise of twenty-five degrees centigrade above the room temperature is allowed. In Germany a rise of thirty-five degrees is permitted, which adds ten degrees to the allowable working temperature and considerably increases the rating of the machines. Moreover, according to the German rules, different temperature rises are permitted for different classes of insulation. Cotton is allowed the least temperature rise, which is followed by paper with an addition of ten degrees, while mica and asbestos are permitted about thirty degrees rise as compared with cotton. In the British and American rules it is stated that when the latter materials are employed a greater temperature rise is allowable, but no limits are given. The author thinks that this is a step in the right direction, as there is no reason why a machine insulated with asbestos and mica should be operated at a temperature as low as that allowed for one insulated with cotton. But the great danger resulting in such classification is the opportunity offered for fraud, on account of the inability of the purchaser to determine whether all of the insulation of a machine is really of a fireproof nature or not. It is not probable that any conscientious engineer would ever accept electrical apparatus operated at a temperature of 125 degrees, regardless of the class of insulation employed, and it is doubtful whether many German engineers would accept such machines; yet this temperature is permitted by the German rules for certain classes of insulation. For example, squirrel-cage rotors, according to the American rules, must not rise above eighty degrees centigrade. The German rules allow eighty-five degrees for cotton, 105 degrees for paper, and 125 degrees for mica. The American rules limit transformer temperatures to eighty-five degrees. The German rules allow a rise to ninety-five for cotton, and 105 and 125 for paper and mica, respectively. The American rules limit the temperature rise with a continuous rating of railway motors to 100 degrees, as determined by the thermometer, and 125 degrees, as determined by the resistance of the machine. German rules make no difference between the two methods of determining temperature, and allow a rise to 105 degrees in one hour with cotton insulation, to 115 degrees in the same time with paper, and to 135 degrees if the insulation be mica. The American standards are generally more conservative than the German, while the British, so far as proposed, lie between these two, but are nearer to the former. It is possible that the keener competition in Europe may have something to do with these ratings. Moreover, to secure safe working at higher temperatures the German manufacturers have been studying the use of non-combustible materials. In this country also, the manufacturers have been investigating in this direction, though as yet they show no disposition to increase the temperature ratings, but give the purchaser the benefit of the improved insulation, thus insuring the apparatus longer life and greater immunity from breakdown.—*Abstracted from the Electric Journal (Pittsburg), June.*

An Emanation from Sodium.

A description is given here of the action of what appears to be an emanation, or volatile vapor, liberated by the surface of freshly cut metallic sodium. This was observed by C. E. S. Phillips during the course of some experiments upon the contact potential difference between the alkaline metals and glass. It was noticed that the freshly cut sodium rapidly discharged an electroscope. Further examination showed that this action occurred only if the gold leaf was charged negatively. Little or no effect was produced when it was positively charged. The action could be completely stopped by a membrane of celluloid sufficiently thin to give interference colors. This fact alone points strongly to the discharging action being due to a vapor. In fact, it was found that a slight current of air directed so as to carry the supposed gas away from the charged plate of the electroscope enabled the leaf to retain its charge. This effect is different from that observed with fresh phosphorus, since the vapor of the

latter discharges positive and negative electricity equally well. It does not, therefore, appear to be due to the air becoming ionized by a change occurring at the surface of the sodium, but more probably to the emission of an electrified gas. The rapid oxidation of the surface seems to have little or nothing to do with the existence of the emanation, and it is significant that all action ceases after prolonged heating to the melting point of the metal. However, if allowed to stand for some hours, the sodium shows signs of recovering its power. All portions of the same block of sodium do not exhibit the action to the same extent. This seems to indicate that the effect may be due to a radio-active impurity in the metal, and attempts are being made to concentrate the active parts to decide whether this is the case or not.—*Abstracted from Nature (London), May 28.*

Electric Driving in Cotton-Spinning Factories.

A discussion is given here by William Hanna of the opportunities offered to the British cotton-spinning factories to increase and improve their output by the introduction of the electric drive. Of all the textile trades in Great Britain, cotton spinning seems to be the most important, and it has reached a remarkably high state of perfection and organization. In Lancashire alone there are now about 56,000,000 spindles running, and the power required to drive these is about 1,000,000 horse-power. This is a figure well in excess of the aggregate output of all the electric-power stations in the British Isles and more spindles are being put into service every year. If, therefore, it can be proved that the electric drive is advantageous for cotton spinning a great boom in the electrical manufacturing business should follow. This method of driving has not been taken up very widely, and at present there are about 1,500,000 spindles only being, or about to be, driven electrically. A sufficient number of good results have been obtained to demonstrate some of the advantages which have been claimed for this method, so that the outlook for the further introduction of electric driving is good. It is to be remembered, however, that the efficiency of operation of a modern cotton-spinning factory is high, taken as a whole. Mechanical engineers are entirely conversant with the requirements of the business, and have brought the mechanical drive to a high state of development, so that whenever a change is contemplated it behooves an electrical engineer to be very judicious in advising or introducing the electric system. More or less experience in this matter is necessary to insure success. The general layout and construction of modern factories vary but little. The mills practically all follow the same plan, but with regard to the selection and proportion of the various protective machines and other details, hardly two are alike. As a rule, each mill makes its own specialties and keeps to one class of cotton and spins one or two counts of yarn. Hence, every factory must be considered separately. In each factory just sufficient preparing machines are installed to keep the spinning and finishing machinery in full operation. The production is practically continuous in all its stages, consequently every machine is kept on or about full load, and the load-factor of the whole mill is uniformly high. When this is the case individual driving is hardly advisable, as a separate motor for each carding machine, for example, would not be economicaliy successful. A carding machine takes about one horse-power, and the number of cards installed in a modern mill is great enough to admit of the arrangement of several groups, each group being driven by a motor of sufficient capacity and speed. Group-driving should also be adopted for the combers. Drawing frames, roving frames and other machines having frequent stoppages usually require power enough to admit of the individual drive, but when speed-reduction gearing is required, group-driving is again more economical. There are two distinct types of spinning machines in use at the present time: The self-acting mule and the ring frame, Grouping is the only satisfactory method of driving mules on account of the varying power required by each machine. Ring frames are cheaper to install and operate than mules, but are now used only for coarse yarns; hence any improvement affecting the running properties and increasing their usefulness is eagerly sought. With electric driving the range of this machine has certainly been extended with gratifying results. The load is steady and the stoppage infrequent and the speed high, so that the induction motor is ideal for driving them. Sometimes machines can be grouped together in pairs, driven by a single larger motor, with excellent results. It should be remembered that the cotton-rope drive is very efficient, and under good conditions there is no slippage at this end of the line-shaft, but the belts to the machines give rise to considerable fluctuation in the speed. Hence, merely to replace the ropes by a large electric motor, as has been done in a number of installations recently, is really a retrogression as far as internal economics goes. Success can only be looked for by judicious grouping of machines. For cotton-spinning machinery the polyphase motor is excellent, and seems to have given better all-around service than any other type. When induction motors are used, supplied from a turbo-generator, there is a very noticeable improvement in the quality of the yarn spun.—*Abstracted from the Electrical Engineer (London), May 29.*

The Value of Metallic-Filament Lamps.

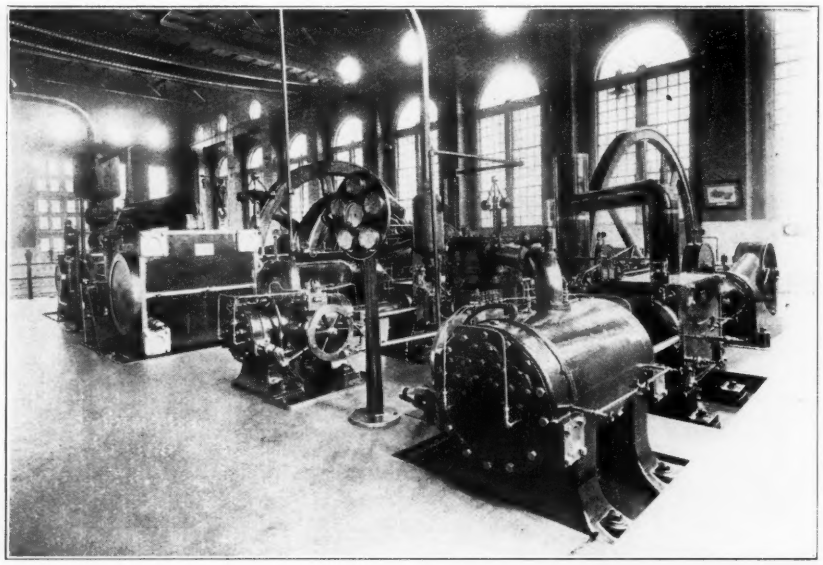
During the discussion of the paper read recently by Hugo Hirst, on "Recent Progress in Tungsten Metallic-Filament Lamps," which was published in the ELECTRICAL REVIEW for June 13, Dr. Louis Bell said that the large size of the lamps first introduced was welcome, as it enabled them to be substituted for the extremely uneconomical enclosed-arc lamp. Enclosed arcs, operating at eighty volts on a 120-volt circuit, furnish about as striking an example of lack of economy as could well be found. In America the manufacturers have been slow to turn out lamps of lower candle-power, but the importation of German lamps has forced them to it. These lamps have an excellent life and have been very successful. In making life tests of them, he had noticed that the specific emissivity seemed to change during the life of the lamp, so that it was a common thing in taking life curves to find individual lamps, and sometimes nearly all in a batch, rising in candle-power after a fall of ten or twelve per cent. These lamps eventually break after a very long life. An important question regarding the use of the metallic lamps is the most economical efficiency at which to run them. At one watt per English candle most of the lamps are being overrun. At one and one-half watts the life is excellent, and it will probably pay to operate the small forty-watt lamps at about this efficiency. As the metallic lamps have an intrinsic brilliancy of between 1,000 and 2,000 candle-power per square inch of incandescent surface, they should never be used unfrosted or without suitable shades. Dr. Bell said that one of the leading central station managers in the United States recently told him that he purposed putting out tungsten lamps free, as he had found that every time he reduced his price to his customers, he increased his net profits.—*Abstracted from Electrical Engineering (London), May 28.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Allis-Chalmers Air Compressor at Pettibone-Mulliken Company's Plant, Chicago.

The advantages of compressed air for innumerable purposes about the modern manufacturing plant, such as the chipping and cleaning of castings by means of pneumatic tools, and in many other ways, have been realized to the fullest extent in the plant of the Pettibone-Mulliken Company, of Chicago, Ill., manufacturer of railway supplies. An interior view of the whole power plant is reproduced and shows one of the Allis-Chalmers heavy-duty two-stage air-compressors installed.



INTERIOR VIEW, PETTIBONE-MULLIKEN COMPANY POWER PLANT.

The steam cylinders of the newer compressor are twelve and twenty-four by thirty-six inches, and the air cylinders twenty and twelve by thirty-six inches, this being practically a duplicate of the older machine installed some time previous. This compressor was designed to furnish 1,200 cubic feet of free air per minute at a discharge pressure of 105 pounds.

Two-stage compression is now recommended by experienced engineers for anything beyond very moderate pressures, the air being thoroughly cooled between stages by intercoolers such as that furnished with the above-named machine; so as to take full advantage of the economy obtainable from this system.

A New Testing Wattmeter for Direct-Current Circuits.

Periodical meter calibration is of vital importance to every central station or isolated plant on account of the fact that the revenue received from the sale of electrical energy is dependent on the accuracy of the meters in use.

Although the customary method of testing with indicating instruments is quite accurate, the rapid growth of the lighting and power industry has necessitated a demand for a meter with which these tests could be made more quickly and still retain the same high degree of accuracy. To meet the demand for this type of meter the General Electric Company, Schenectady, N. Y., has just placed on the market the Thomson direct-current test meter which is known as the Type "CB."

As may be seen by referring to the illustration, the meter is enclosed in a substantial carrying case of quarter-sawed oak with an antique finish and owing to its small size is very convenient to handle. The entire meter can be lifted from the case by two buttons on opposite sides, thus making it easily accessible for calibration and when removed from the case will remain without support in an upright position. The register is large and its location on the top of the meter enables the indications to be easily read. This feature is particularly advantageous when making tests in places where there is no opportunity to place the meter close at hand and it must be set on the floor or some other place below the observer.

The register is of the three-pointer type. The largest pointer indicates directly on the dial the disc revolutions. This dial can be read to hundredths of a revolution. The two smaller pointers make one revolution, respectively, for each ten, or 100 revolutions of the large pointer. It is, therefore, a simple matter to ascertain the number of revolutions of the disc by noting the position of the three pointers at the start and finish of each test.

In order that low friction be maintained for a long period, it is necessary that the pivot and jewel be of the hardest possible material, and to this end the cup diamond jewel has been adapted for the lower thrust bearing in this type of meter. The pivot in the shaft end is drawn from the highest grade wire, glass-hardened and highly polished.

G. E. TEST METER.

This type of meter can be furnished in two distinct ratings, 1-2-10-20-40 amperes or 5-10-50-100 amperes, each with

single 110-volt or double 110—220-volt potential windings—as may be desired. This latter form is particularly desirable for stations having the Edison three-wire system of distribution. The potential winding is suitable for use on voltages ranging ten per cent on either side of normal.

The 1-2-10-20-40-ampere meter has two current windings, one divided in two sections, the other in four. By means of plugs and connection straps these windings may be connected in series or multiple, giving the five different current capacities. This same method is followed in the 5-10-50-100-ampere meter. With any one of the combinations the torque developed is the same, provided the meter operates at the same per cent of full load. In other words, when using the one-ampere winding with one ampere flowing, the torque is the same as that developed by the forty-ampere combination with forty amperes flowing. This feature is extremely valuable as the test meter is never operating under light-load conditions, thus eliminating any possible inaccuracies which might occur if it were operated at extremely light loads.

The five separate windings of the 1-2-10-20-40-ampere meter render it possible to obtain accurate registration from a ten-watt load to a four-kilowatt load.

Sprague Octagon Box No. 6250.

The Sprague Electric Company, 527 West Thirty-fourth street, New York city, has recently put on the market an improved stamped steel outlet box which is known as Octagon Box No. 6250. This box is a departure from former practice

Sprague Octagon Box No. 6250.

in the stamped steel line and will be popular with the electrical trade. This box affords absolute security and substantial metallic continuity, avoiding partial contacts between bushings or lock-nuts and curved surfaces of round boxes. This box overcomes that defect by having flat sides and round corners. The flat sides give the full contact and the round corners save space. The box is smaller than a round box of the same diameter or a square box of the same width. The Octagon box and a full line of standard covers are furnished in galvanized or black enamel finish. The covers are also furnished in old brass, oxidized copper, polished copper and nickel finish. These covers are interchangeable with standard three-quarter-inch round boxes.

Allis-Chalmers Mining Machinery for the Benito Juarez Mines Company.

The Benito Juarez Mines Company, Salinas, San Luis Potosi, with mines at Penon Blanco, Mexico, will shortly have in operation a new 150-ton mill and cyanide plant whose equipment of machinery has been contracted for with the Allis-Chalmers Company, Milwaukee, Wis.

This plant will comprise a battery of twenty 1,050-pound stamps dropping in deep mortars of the El Oro type, a No. 3 style "D" Gates breaker, a sixteen-foot wet grinding tube mill and a Dorr classifier. There will be twenty-three steel cyanide tanks for sand and slime treatment, and a complete precipitating and refining outfit. Both the mill and the several mines of the company at Penon Blanco will be operated by electricity. The electrical energy will be generated at a power plant located beside the railroad tracks at Salinas station. It is expected to use Ebano fuel oil.

The power-plant equipment comprises two 260-horse-power Stirling boilers for operating two twelve and twenty-four fourteen-inch cross-compound engines direct-connected to two 150-kilowatt Allis-Chalmers engine-type alternators. Electric motors, either direct or belt-connected, will be used to drive the various machines in the plant. There are some fifteen motors, all of Allis-Chalmers induction type, ranging from one-half horse-power to fifty horse-power in capacity. The batteries will be operated by a fifty-horse-power machine operating at 680 revolutions per minute, the crusher by a fifteen-horse-power motor at 850 revolutions per minute, and the tube mill, which is a three and one-half-foot by sixteen-foot Allis-Chalmers wet grinding mill, will be operated by a twenty-horse-power motor at 850 revolutions per minute. The current will be transmitted twelve miles to Penon Blanco. A great economy will be effected by this arrangement, as it avoids the necessity of hauling fuel up-hill from Salinas to Penon Blanco, and will obviate the necessity for separate power plants to operate hoists, pumps and air-compressors at the various mines, which extend over a distance of about two miles.

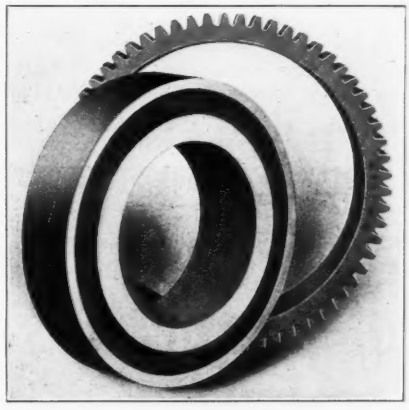
The Benito company has suspended its shipments to the Aguascalientes smelter and is storing up the ore extracted in its development work pending the completion of the mill. It has been demonstrated that the saving in the cost of sorting, hauling, railroad freight and smelting charges, by milling all ores at Penon Blanco, will result in an additional profit to the company of about $15 per ton.

T. J. Leavitt, formerly chief electrician of the Real division of the Real del Monte Company at Pachuca, is in charge of the mechanical and electrical departments of the Benito Juarez Company.

A New Removable Rolled-Rim Gear.

The illustration shows a new gear for high-speed and heavy-haulage trolley service now being placed on the market by the R. D. Nuttall Company, Pittsburg, Pa. In conformity with the well-established principle of this company the gear, known as the Nuttall removable rolled rim, was first put to severe tests in actual service. In all of these tests the performance proved exceptionally satisfactory.

The rim is made of a special grade of rolled steel of high tensile strength, and is shrunk on a cast-steel centre. Thus the



Removable-Rim Gear.

two members become practically a single piece. When worn, however, the rim can be easily removed and replaced at nominal cost so as to make a practically new gear.

The rim can be attached to any style of centre or spider. It is not limited to trolley service, but can be applied to any service where the diameter does not exceed ten feet.

The Brilliant Electric Company "Tungstoliers."

The Brilliant Electric Company, Cleveland, Ohio, has placed on the market a

FIG. 1.—"MISSION" FIXTURE.

fine line of fixtures which it has designated as the Brilliant "Tungstoliers." The accompanying illustrations show a few examples of this line of fixtures. These constitute concrete units which have been de-

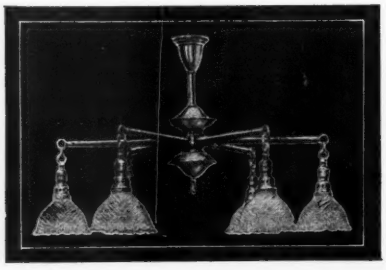


FIG. 2.—"AURORA" FIXTURE.

veloped along absolutely scientific lines, and combine the Brilliant tungsten lamp, which is equipped with proper Holophane reflectors, and specially designed nickel-

FIG. 3.—"MERCURY" FIXTURE.

plated supporting members. They are supplied ready wired and complete, including lamps and reflectors, and are designed to produce definite, predetermined results in foot-candles of illumination, properly distributed over given areas. These "Tungstoliers" are at once the most efficient and desirable units available for interior lighting. While they are correctly designed for general illumination, they

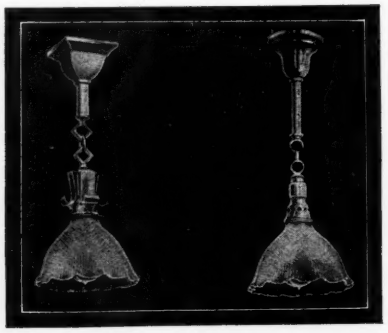


FIG. 4.—"SATURN" AND "NEPTUNE" FIXTURES.

can be adapted by the company's engineers to fit special cases and conditions.

In the accompanying illustrations Fig. 1 shows the "Mission" Brilliant tungsten lamp unit. This is a very popular fixture for many classes of installation. Fig. 2

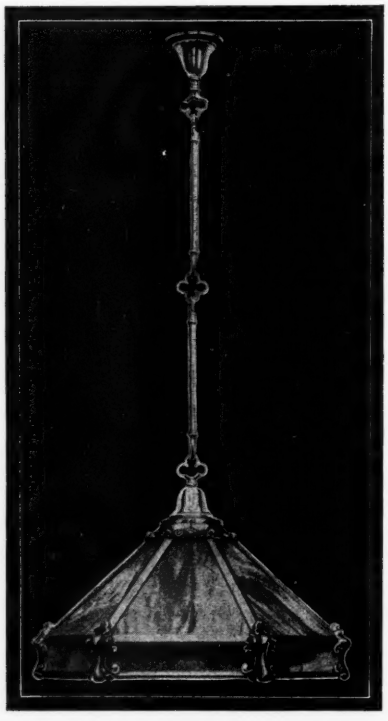


FIG. 5.—"VENUS" FIXTURE.

shows the "Aurora." This unit is specially designed for store lighting, where a wide spread of illumination is desired. Fig. 3 shows the "Mercury." This is a substantial unit for general use and will fit into any scheme of decoration. Fig. 4 shows two forms of unit. The unit with the straight-line fixture is termed the "Saturn," and the one with the round lines the "Neptune." Both are one-light units, and will conform to any lighting scheme. The length of the light unit is twenty inches. Fig. 5 shows the "Venus," also a one-light unit, but equipped with an artistic dome applicable in the store window, over the dining-room table, wherever fine wares are displayed, and in a hundred other places. The length of the unit is fifty-six inches.

The Brilliant tungsten lamps, thirty-two-candle-power, forty-watt; forty-eight-candle-power, sixty-watt, and eighty-candle-power, 100-watt, are used.

The Armor-Plate Vaults of the Carnegie Safe Deposit Company.

On Thursday, June 11, the Carnegie Safe Deposit Company entertained a large number of representative New York business men and newspaper men at a reception attendant upon the opening of the new armor-plate vaults located in the Trinity Building at 115 Broadway, New York city. The vaults are entirely constructed of armor plate five inches thick, and the statement is made that the weight of the armor plate used is greater than the weight of armor plate on any American ship afloat. Entirely surrounding the armor plate is a fire wall of concrete, twelve inches thick. Underneath the vaults is ten feet of alternate layers of concrete and railroad rails laid flange to flange, built up from the bedrock of Manhattan Island. The vaults comprise two stories, the lower vault being 108 feet long, thirty-one feet wide and ten feet high; the upper vault being eighty-five feet long, twenty feet wide and ten feet high. An elevator serves the two floors of the vaults.

The ventilation system supplies filtered air, either cooled or heated to the temperature desired. A complete change of air is effected every five minutes.

The spectacular features of these vaults are the doors, seven and one-half feet in diameter, at each end of the upper vault. These each weigh twenty-five tons, and are forged in one solid piece of armor plate. The front plates, upon which the doors are hung, weigh thirty tons each, and are the largest pieces of armor plate ever forged. Each bolt in the big doors weighs 100 pounds, and there are twenty-four of these bolts in each door. The bolts work a locking mechanism weighing five tons.

To move this great weight a new time lock was invented. When the door is closed an electric motor on the inside of

the door throws the bolts automatically. It is then beyond human power to open the door until, at the hour predetermined, the time locks release the bolts from their grip upon the neck of the vault.

Printing Attachment for Power Wattmeters.

The accompanying illustration shows one week's registration, giving the quantity of electricity consumed during each hour of the entire week, by means of the "Chicago" printing attachment for integrating wattmeters. This attachment can be applied to any high-grade direct-current or alternating-current, single or polyphase integrating wattmeter, and prints in ordinary figures on a one and one-half-inch strip of paper the actual

PRINTING ATTACHMENT FOR WATTMETERS.

registration in kilowatt-hours at the end of every fifteen-minute, or longer, interval as may be desired. This printed record is removed and a new roll of paper inserted at the end of each week. The printed registration slip shows the actual consumption during every fifteen-minute, or longer, interval, from which can be immediately ascertained the particular hour of the day and day of the week when the maximum demand occurred. This maximum is not momentary, but is the average for the fifteen-minute, or longer, period desired as registered by the integrating wattmeter.

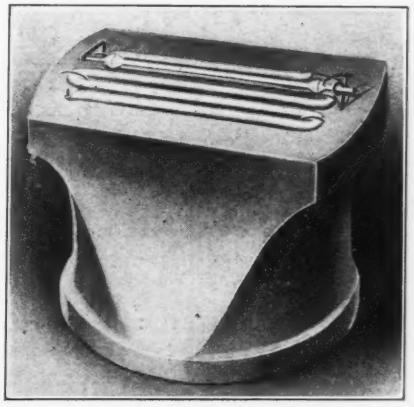
The "Chicago" printing attachment is especially advantageous in the sale of electric power, and particularly for large consumers. It enables the central station or power company to know absolutely all the vital conditions and hence the cost of the energy which it supplies to the particular consumer, and lends itself to the sale of power under different methods.

The accuracy of the reading of the "Chicago" attachment is limited only by the accuracy of the wattmeter, the error of which may be reduced as low as one-half of one per cent. The use of the printing attachment eliminates all possible disputes regarding the reading of the meter, as the readings are printed in plain figures. The printing attachment takes no additional space on the switchboard, and requires the calibration of only one instrument. There has been a great deal of interest manifested in the device, and while it was intended in the first place for installations of 150 horse-power or over, a great many customers expect to use it on small installations.

The Minerallac Company, Monadnock Building, Chicago, Ill., is the sales agent for this device.

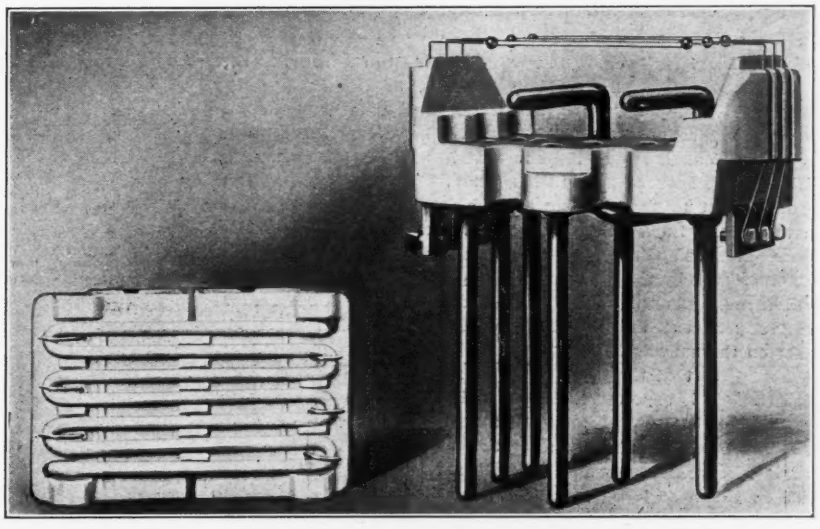
A New Nernst Lamp Holder.

The Nernst Lamp Company, Pittsburg, Pa., is putting on the market a new type of holder for use in connection with multiple glower lamps. It is to be known as the "Wafer" holder and is characterized by extreme simplicity of design. The part from which it gets its name takes the place of the heater tubes used with the older holder and does away with the use of the heater porcelain entirely. The wafer consists of a long thread of heater material wound back and forth over the surface of a porcelain base and firmly attached to it by means of wires. The wafer is secured in position by two wire prongs, which at the same time serve as terminals, to which it connects automatically. The holder porcelain is provided with a groove to admit the wafer. The wafer can be changed in a moment's time. It requires no instrument for its removal, and the operation can in no way injure or interfere with the glowers or connections.



SHOWING THE UTILITY OF THE NEW NERNST LAMP HOLDER.

Since the testing and replacement of heater tubes has always been one of the chief items in the maintenance of Nernst lamps, the labor required to maintain them will, through the use of the new holder, be greatly reduced. Likewise the cost of maintenance will be reduced, since the heater porcelain will not have to be considered.



THE "WAFER" NERNST LAMP HOLDER.

The successful development of this heater permits of a non-renewable holder for single glower units, employing horizontal glowers. The use of such a renewal in the single-glower units simplifies the maintenance, as no mounting of heaters and glowers is required—in fact, the trimming of the single-glower lamp is similar to that of incandescent lamp systems, except that the renewal is "pushed" into place instead of being screwed into place.

Current Electrical News

DOMESTIC AND EXPORT.

BIG IMPROVEMENTS AT ASHLAND, WIS.—The new management of the Ashland Lighting Company has voted $450,000 of bonds to extend the lines of the street-car system through the residence portion of the city, to build a new gas plant, to buy more cars and secure its own water-power and power plant. The directors also ratified the recent action of buying Prentice Park and about sixty acres of land, and elected as new directors C. L. Wright, of Chicago; F. T. Sullivan, of Chippewa Falls, and M. M. Reed and A. E. Appleyard, of Boston. Mr. Appleyard is the moving spirit in the new management. The line will be extended to Washburn, also to Odanah and the Copper Falls water-power eighteen miles from Ashland will be developed.

ANNUAL MEETING OF INDIANAPOLIS TRACTION AND TERMINAL COMPANY—The annual meeting of stockholders of the Indianapolis Traction and Terminal Company was held June 10 in the offices of that company in the Terminal Building. The old board of directors was re-elected and the statement of the earnings of the company was read. The company made a good showing despite the industrial depression during the last months of the year. Gross earnings for 1907 were $2,680,506.41 and the net earnings during the same time totaled $315,560.19. A verbal statement of the company's earnings during the last five months showed that they would probably equal the earnings of the same time last year. The directors elected were Hugh McGowan, H. P. Wasson, Robert I. Todd, John J. Appel and W. K. Schoepf.

PHILADELPHIA RAPID TRANSIT—It is stated that the new loan of $5,000,000 which President Parsons, of the Philadelphia Rapid Transit Company, has asked the Philadelphia council's consent to, would be of a temporary nature, but President Parsons' letter to the council makes it plain that it will be of a permanent character. Mr. Parsons says in his letter: "For these reasons we ask your assent to the pledging of such franchises, leaseholds and securities, etc." Such authority would mean a new mortgage and a permanent fixed charge. The fixed charges for the fiscal year will be increased by the addition of one per cent to the Union Traction dividend, amounting to $300,000, and if the new bonds bear at least five per cent interest that would be $250,000 more. The interest on the subway bonds will be a charge against income after September 1, so that the increase in fixed charges after July 1 will be material. It is expected that the earnings will be increased after the opening of the subway and that a very large amount of money will be saved to the company after the abolition of free transfers. There is also reason to believe that the claims for damages will be less in the next fiscal year than in this, and the earnings in general may be expected to show an improvement.

UNIFORM RULES ON MICHIGAN INTERURBANS—At a meeting of representatives of nearly every suburban street railway company of the state with the Michigan State Railroad Commission Thursday afternoon, June 4, a general discussion of several topics finally resulted in the appointment of a special committee of the railway men to formulate uniform rules for the management of the lines. Harry Bullen, general superintendent of the Detroit United Railway, was named chairman of the committee, and with him are Streathern Hendrie, of the Grand Rapids & Holland line; Superintendent O'Mera, of the Michigan United Railway, and General Manager Morley, of the Muskegon lines. This committee will hold a series of conferences in Detroit and elsewhere and is expected to report back to the commission within the next two months, and after a further meeting with the commission the report will be submitted to all the roads for adoption, giving the suburban lines of the state a uniform method of operating the roads. One of the matters to receive serious consideration by the committee is that of written orders, where orders outside of those contained in the time tables are given. Chairman Glasgow, of the commission, stated that if it was finally agreed that the written order should be adopted it must be uniform with a third copy of the order left in the telephone booth. This will be a change from any of the written order systems used in the state at the present time. After the Egry system is put into operation on the Monroe & Toledo division of the Detroit United Railways the various railway officials are to be invited to inspect its workings.

EDUCATIONAL NOTES.

MICHIGAN AGRICULTURAL COLLEGE—Michigan Agricultural College, Agricultural College Station, Mich., will dedicate its new engineering building on June 22, the dedicatory exercises being held on the afternoon of that day.

FRANKLIN INSTITUTE NIGHT SCHOOLS—The following schedule has been announced for the Franklin Institute, Philadelphia, Pa., night schools: Drawing School—Winter term, September 15, 1908, to December 17, 1908, with Christmas holidays from December 17 to January 5, 1909; spring term, January 5, 1909, to April 8, 1909. School of Machine Design—Classes in mathematics, mechanics, strength of materials and machine design; winter term, September 14 to December 16, with Christmas holidays from December 16 to January 4; spring term, January 4 to April 7. School of Naval Architecture—Winter term, September 18 to December 18, with Christmas holidays from December 8 to January 8; spring term, January 8 to April 9.

STEVENS INSTITUTE OF TECHNOLOGY—Ninety-four graduates received the degree of mechanical engineer at the thirty-sixth annual commencement of Stevens Institute of Technology, Hoboken, N. J., on June 11. Following the opening prayer by Bishop Edwin S. Lines, President Alexander C. Humphreys made an address, telling of the needs of Stevens and plans for its future. He asked $1,000,000 to carry out much-needed extension work. Included in this work is a larger and better-equipped laboratory of electrical engineering. The honorary degree of science was conferred upon Henry S. Pritchett, Ph.D., LL.D., president of the Carnegie Foundation for the Advancement of Teaching. Dr. Pritchett made the address to the graduates. The salutatory was delivered by Kenneth Hamilton Condit, of East Orange, and the valedictory by Thomas Watts Kirkman, of New York city.

UNIVERSITY OF MINNESOTA—The University of Minnesota has increased the length of its engineering courses from four to five years. This is for the purpose of adding to the amount of general culture work required heretofore, and at the same time rearranging and increasing to a small extent the technical work. It is believed that this will result in turning out a still better grade of engineers, although it may cut down the number of students for a time. The added work consists of additional requirements in modern languages, economics and political science. The first year is uniform for all courses, so that students need not choose their special course until after one year's work at the university. As the first four years provide a good general education, it is proposed to give the degree of bachelor of science at the end of the fourth year. Most of the purely technical work comes in the fifth year, upon the completion of which the degree of electrical, or other, engineer is conferred.

NEW PUBLICATION.

"PATENT PROGRESS"—*Patent Progress* is the latest periodical to make its appearance. This magazine reprints each week the drawings, etc., of all the patents, designs and trade-marks issued by the United States Patent Office, classified so that busy people can see at a glance what is being done in the way of invention in the particular lines in which they are interested. There are also several pages of editorial comment relative to matters of immediate interest to those having to do with any branch of applied science. The magazine is published by the Manhattan Technical Publishing Company, 13-21 Park Row, New York city, at ten cents per copy, or $2.50 per year.

PERSONAL MENTION.

MR. BERNARD E. SUNNY, president of the Chicago Telephone Company, was given the honorary degree of doctor of engineering at the commencement exercises of Armour Institute, Chicago, Ill., on June 4.

MAJOR E. L. ZALINSKI, U. S. A. (retired), has been elected president of the Bureau of Illuminating Engineering, New York city. Major Zalinski is a pioneer in the development of illuminating engineering, and this recognition of his great services to the art and industry is certainly due him.

MR. EDWIN R. WEEKS, of Kansas City, Mo., one of the well-known pioneers in electrical engineering and central station management, delivered an address last week at Columbus, Mo., before the general assembly of the university students and teachers and the women's clubs, on humane work in Missouri, and before the university school of engineering on the value of technical education.

MR. W. J. A. LONDON has recently accepted the position of chief engineer of the Terry Steam Turbine Company, Hartford, Ct., succeeding C. E. Terry, recently deceased. Mr. London's experience in the turbine industry has been extensive, dating from his early connection with the C. A. Parsons Company, Newcastle, England, and about fifteen years later with Brown-Boveri Company, Baden, Germany, and the British and American Westinghouse companies. His work has taken him into the field not only of land turbines, turbo-generators and condensers, but also that of marine propulsion.

MR. ADOLPH HERTZ, statistician of the New York Edison Company, was united in marriage on June 14 with Miss Frances Loewenberg. A farewell luncheon was tendered Mr. Hertz on Saturday, June 13, by his associates and a few friends in the electrical industry. Among those present were Fred Schmidt, A. Nichols, Gustave Lieberman, William Gordon, E. Bondy, Benjamin Wall, Alvin Johnston, H. M. Slauson, J. L. Prince, H. S. Ferguson, W. Miller and Frank Garabrant. A very enjoyable afternoon was spent and Mr. Hertz was sent on his way feeling that he had the best wishes of all for a long and prosperous married life.

NEW INCORPORATIONS.

AUGUSTA, ME.—Chattanooga Electric Company. $3,000,000. President, J. Berry, Augusta.

MADISON, WIS.—Clyde Telephone Company, Clyde, Iowa County. $300. Incorporators: Frank Flannery, Pat Shelton and S. F. Gile.

INDIANAPOLIS, IND.—Carroll Electric Light Company, Delphi. $10,000. Directors: J. H. Burr, Nathaniel Mohr, F. C. Smith and A. V. Smith.

WILMINGTON, DEL.—Postal Telegraph-Cable Company, Wilmington. $50,000. Incorporators: L. Lemon, Philadelphia, Pa.; J. T. Johnson, W. W. Anderson, Wilmington.

INDIANAPOLIS, IND.—Farmersburg Telephone Company, Farmersburg. $10,000. Directors: Ameridath J. Aikers, James Branson, Thomas H. Kendall, Arthur Hook, George Bennett, Harvey Lewis and James H. Forbes.

MAMMOTH SPRING, ARK.—Mammoth Spring & Memphis Long-Distance Telephone Company. $3,000. W. B. Pace, president; E. C. Bellamy, vice-president; C. W. Dixon, treasurer, and L. M. Hynson, secretary and general manager. To connect at Imboden with the Bell system.

INDIANAPOLIS, IND.—Vincennes & Wabash Transit Company. $60,000. Directors: J. J. Burns, Chicago; M. C. Peoples, Monroe City; C. F. Burns, Chicago; W. W. Claycomb and G. S. Nosette, Monroe City; J. F. Munro, Chicago, and P. M. Davidson, Troy. To construct and operate an interurban line from Vincennes, through Monroe City, Washington, Green and Martin counties, Bloomington, and from Linton to Bloomington. The general offices are to be located at Monroe City.

PARKERSBURG, W. VA.—The Union Traction Company, with headquarters at Sistersville. The line to commence near the division line between Wetzel and Marshall counties, and run thence to New Martinsville, on to Brooklyn, to Paden City, to Sistersville and thence to St. Marys, in Pleasants County. $150,000, with $50,000 paid. Incorporators: H. W. McCoy, G. E. Work, S. G. Messer and R. Broadwater, of Sistersville, and I. D. Morgan and E. L. Robinson, of New Martinsville.

ELECTRICAL SECURITIES.

Notwithstanding the many items which in ordinary times would affect the stock market, dormant conditions existed almost the whole week. Present prices discounted any result which might have been hoped for on good news, and the adverse factors only served to increase the hesitancy which has characterized the attitude of outside speculators for some weeks past. The price cut in steel and iron seems just at present to have been ineffective, but it is hoped that it will help over the dull period now ensuing. Present indications point to a bountiful cereal crop, and with the depleted condition of the stores of foreign countries this should mean large rewards for our farmers. The principles to be enunciated by the dominant political party this week are awaited with world-wide interest, not to say anxiety. It is pretty well established, however, that immediately after the close of the coming national conventions, business will take a quick turn for the better, no matter what may be the outcome of the dictum of the politicians.

Dividends have been declared upon the following electrical securities: United Gas Improvement Company, Philadelphia; regular quarterly dividend of 2 per cent, payable July 15. Portland (Ore.) Railway, Light and Power Company; regular quarterly dividend of 1¼ per cent upon the preferred stock, payable July 1 to stockholders of record June 15. Mexican Light and Power Company; a dividend of 1 per cent on the common stock. This is not a quarterly or half-yearly dividend, but simply 1 per cent declared to the shareholders out of earnings. The present dividend is payable July 15 to shareholders of record June 30. Manhattan Railway Company, New York city; guaranteed quarterly dividend of 1¾ per cent, payable July 1. Chicago City Railway Company; regular quarterly dividend of 1½ per cent, payable June 30. Columbus Railway and Light Company; dividend of ½ per cent on the capital stock, payable June 15 to stock of record June 1. Union Traction Company, Philadelphia; regular semiannual dividend of 2½ per cent, payable July 1. Western Union Telegraph Company; a quarterly cash dividend of ½ of 1 per cent. The old rate was 1¼ per cent. The last two dividends were made payable in stock. The Western Union dividend is payable July 15. Books close June 20 and reopen June 22. Bell Telephone Company of Missouri; regular quarterly dividend of 2 per cent, payable July 1. Cumberland Telephone and Telegraph Company; regular quarterly dividend of 1¾ per cent, payable to stockholders of record June 20. Stark Electric Company, of Canton, Ohio; an initial quarterly dividend of ¾ of 1 per cent on the $1,000,000 stock, payable July 1 to stock of record June 25. Louisville Traction Company; regular quarterly dividend of 1 per cent on the common stock, payable July 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JUNE 13.

New York:	*Closing.*
Allis-Chalmers common	9¾
Allis-Chalmers preferred	29⅞
Brooklyn Rapid Transit	46⅞
Consolidated Gas	121½
General Electric	134
Interborough-Metropolitan common	10½
Interborough-Metropolitan preferred	28¼
Kings County Electric	112
Mackay Companies (Postal Telegraph and Cables) common	65¼
Mackay Companies (Postal Telegraph and Cables) preferred	64¾
Manhattan Elevated	133
Metropolitan Street Railway	23
New York & New Jersey Telephone	100
Western Union	54
Westinghouse Manufacturing Company	46
Boston:	*Closing.*
American Telephone and Telegraph	118¼
Edison Electric Illuminating	209
Massachusetts Electric	46
New England Telephone	111
Western Telephone and Telegraph preferred	60
Philadelphia:	*Closing.*
Electric Company of America	10⅛
Electric Storage Battery common	31
Electric Storage Battery preferred	31
Philadelphia Electric	9½
Philadelphia Rapid Transit	13½
United Gas Improvement	84⅞
Chicago:	*Closing.*
Chicago Telephone	129
Commonwealth Edison	97
Metropolitan Elevated preferred	48
National Carbon common	66
National Carbon preferred	110

ELECTRIC LIGHTING.

CARTHAGE, MO.—A $3,975 contract for the improvement of the municipal electric light plant has been awarded.

COLLINGSWOOD, N. J.—A committee has been appointed to look into the matter of installing a municipal gas, water and electric plant.

MINNEAPOLIS, MINN.—The board of aldermen has granted the Minneapolis General Electric Company a satisfactory renewal of its franchise for thirty years.

POSEYVILLE, IND.—Frank Seib, Joseph Shaffer, Herman Stallings, Martin Dilger and August Seib have formed a company to install an electric light plant at Poseyville. The capital is to be $10,000.

WENATCHEE, WASH.—The county commissioners have granted a franchise to the Entiat Power Company to erect poles and wires on the public highways in the county to transmit power for heating and lighting. The franchise will run thirty-seven years.

LAFAYETTE, IND.—At a meeting of the directors of the Merchants' Electric Light Association Charles Fleming, of Indianapolis, was awarded the contract for all the outside work to be done in connection with providing the city with new street lights.

ROCKPORT, TEX.—The Rockport Ice and Light Company, through its manager, R. H. Ellis, has closed a contract with Turner & Prior, electrical engineers, for the installation of a modern electric light plant in Rockport. Work will begin at once.

CUMBERLAND, WIS.—The city council has ordered a special election to be held June 29, for the purpose of voting upon the proposition to borrow $25,000 from the state. The money is needed to install a new electric light and water plant and for other purposes.

LITTLE ROCK, ARK.—A decree of foreclosure has been entered in the United States Court in the case of the New York Trust Company, of New York, against the Pine Bluff Light and Water Company for $525,000 and the property of the light company was ordered sold.

LAWRENCE, MASS.—The Pacific Mills will shortly place in operation at its mills a 3,000-horse-power electric plant. The plant is equipped with three steam turbines of 1,000-horse-power capacity each, and the building is constructed on lines which will permit an increase in the capacity to about 12,000 horse-power.

NEW YORK, N. Y.—Plans have been filed for enlarging and remodeling the two and three-story power station of the United Electric Light and Power Company on 146th street. A three-story extension will be added and the operating gallery enlarged. The improvements are to cost $18,000. Frank W. Smith is the architect.

JERSEY, CITY, N. J.—Mayor Wittpenn has vetoed an ordinance giving the Mutual Benefit Electric Light and Power Company permission to lay wires underground to furnish electricity for light, heat and power. The mayor said he did not feel that such franchises should be granted unless reasonable assurance is obtained that good results would follow.

NORFOLK, VA.—Federal Judge Edmund Waddill, Jr., has directed the issuance of $6,000 in receivers' certificates in the bankruptcy proceedings of the Public Service Corporation, of Hampton. These certificates are to be issued in sums of $500 and to be used by Receivers Whetstone and Dudley in making necessary extensions and bettering the lighting plant of the bankrupt concern.

GREEN BAY, WIS.—The Stephenson Hydro-Electric Company, of Marinette, is arranging to string wires to this city and to furnish power to factories over the equipment of the Green Bay Gas and Electric Company. It is said that the Stephenson company intends to convey a large part of the power generated at its 5,000-horse-power plant at Chappie Rapids on the Menominee River to Green Bay.

WESTERLY, R. I.—At a recent meeting of the stockholders of the Westerly Light and Power Company, held in Providence, these officers were elected: William Clark, of Westerly, president; Walter L. Mauran, vice-president; T. E. Steere, secretary and treasurer; Herbert B. Rust, general manager; Stephen O. Metcalf, Henry F. Lippitt, William L. Hodgeman, directors; Martin H. Spellman, local manager.

TACOMA, WASH.—Mary D. Fairbanks, wife of the local manager of the Westinghouse Electric and Manufacturing Company, has filed a petition asking for valuable water right privileges on the Puyallup River and on Lake Kipowsin. On the Puyallup River she asks for 1,500 cubic feet of water per second and at Lake Kipowsin 500,000 cubic feet per second. Both locations are valuable for water power plants.

ST. LOUIS, MO.—Articles of incorporation have been filed by the West End Light and Power Company. The incorporators are: Arthur R. Kloos, manager of Browning, King & Company; J. D. Dana and S. L. Swarts, and the capital stock of the company is $50,000. The company has purchased the franchise held by Browning, King & Company, which was granted several years ago. The franchise gives it all the rights and privileges necessary to generate and sell electric current.

SIDNEY, IOWA—A stock company of about twenty business men has been organized to put in an electric light plant at Sidney. The company is capitalized at $15,000, $8,000 of which is paid up. An election has been called for July 1 to grant the company a franchise. The company is to be known as the Sidney Electric Light, Heat and Power Company. J. S. Hodges is president; A. V. Penn, vice-president; C. J. Esden, treasurer, and A. Wildbinger, secretary. Board of directors: L. Wankel, C. A. Metelman, W. S. Stephens, T. E. James and F. Branden.

ST. LOUIS, MO.—The West St. Louis Water and Light Company is arranging to issue $1,000,000 of new bonds which are to be voted at a special stockholders' meeting July 2. The new bonds will be used to pay off and retire the present bond issue of $600,000 put out five years ago on which the interest rate is six per cent. The majority of these bonds are held by the directors of the company. The new bonds will be five per cent. Authority will also be given the directors to issue an additional $1,000,000 of bonds to be included under the first mortgage.

CLEVELAND, OHIO—A group of Cincinnati capitalists is said to contemplate harnessing the waters of Paint Creek, in Ross County, Ohio, to generate power. The company which is being organized intends to erect a ninety-foot dam. The main dam and power plant are to be erected at Alum Cliffs, but two smaller storage dams are to be erected in the creek between the big dam and Greenfield to keep a full head of water at the large dam. It is claimed that power enough will be generated to supply Cincinnati, Dayton, Hamilton, Springfield, Columbus and all southern Ohio.

BUFFALO, N. Y.—The stockholders of the Niagara Falls Power Company have elected the following as members of the board of directors: Edward D. Adams, John Jacob Astor, Temple Bowdoin, Charles Lanier, Joseph Laroque, Darius O. Mills, Ogden Mills, Victor Morawetz, Francis Lynde Stetson, Frederick W. Whitridge, Edward A. Wickes, of New York; DeLancey Rankine, of Niagara Falls, and Edward T. Stotesbury, of Philadelphia. The annual meeting of the stockholders of the Canadian Power Company was also held at Niagara Falls, Ontario, and resulted as follows: William H. Beatty, W. H. Brouse, Wallace Nesbit, of Toronto; A. Munro Grier, of Niagara Falls, Ontario, and DeLancey Rankine, of Niagara Falls, N. Y.

CHATTANOOGA, TENN.—The Chattanooga Electric Company has applied, in the state of Maine, for a charter in order that it may take over the local plant of the Chattanooga Electric Company, incorporated under the laws of New Jersey. Application for the privilege to transfer the franchises to the new company has been made to the city by the local attorneys. The object of the change is to increase the capitalization of the company in order that a number of improvements may be made on the local plant. A similar change was made four years ago when the name of the local company was changed from Chattanooga Light and Power Company to the Chattanooga Electric Company. At that time the capitalization of the company was materially increased in order to allow for the improvements in accordance with the growth of the city, as it is the policy of the company to increase its capitalization instead of issuing bonds. Since the last time a change was made in the incorporation, all of the surplus capital has been used up in improvements. It is said that over $200,000 a year is consumed by the company in keeping up with the progress and growth of the city. One improvement which will probably be made on the plant in the near future is the installation of a new turbine.

ELECTRIC RAILWAYS.

BABYLON, N. Y.—The village board has granted a franchise to the South Shore Traction Company.

LOS ANGELES, CAL.—San Bernardino supervisors have sold a railway franchise from Redlands to Redlands Junction to John H. Fisher, of Redlands.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company has authorized an issue of $1,800,000 six per cent convertible notes, of which $1,358,000 have been sold to Philadelphia and Baltimore bankers.

AUSTIN, TEX.—The Northern Traction Company, of Fort Worth, has increased its capital from $2,500,000 to $3,000,000, and the El Paso Electric Railway Company, of El Paso, from $750,000 to $1,500,000.

BUFFALO, N. Y.—The Buffalo & Lake Erie Traction Company, organized to build a trolley line between Buffalo and Erie, has placed in operation the first division of its line, which extends to Wanakah, a distance of eight miles.

NEW ROCHELLE, N. Y.—Permission has been granted the Westchester Electric Railway Company to issue $90,000 in bonds for the purchase of new cars running on the line between Larchmont, New Rochelle, Mount Vernon and New York.

AUBURN, N. Y.—N. L. Bundy, of the Auburn & Cortland Electric Railroad, reports that work on the Cortland end of the line will begin in a few weeks, and be pushed throughout the summer in the endeavor to complete the thirty-six miles of track before the end of two years.

SAN FRANCISCO, CAL.—The board of supervisors of Alameda County has granted A. W. Maltby and Joseph Napthaly permission to construct and operate an electric railway through the tunnel which penetrates the Berkeley hills, connecting Alameda and Contra Costa counties.

TOLEDO, OHIO—The Chicago, Lake Shore & South Bend, which, on July 1, will begin operation as an electric railroad between South Bend and Chicago, has given a trust deed for $350,000 to the Cleveland Trust Company, of Cleveland, to secure a six per cent bond issue running twenty years.

CHEYENNE, WYO.—A twenty-five-year electric street-railway franchise has been granted by the city council to T. A. Cosgriff. The franchise provides that work must begin within thirty days and the system be in operation within six months. An electric lighting clause is embodied in the franchise.

FREEPORT, ILL.—Local capitalists are back of a project to build an interurban railroad from this city northward through the villages of Cedarville, Red Oak, Buena Vista and Orangeville, Ill., and to Monroe, Wis., a distance of about thirty-five miles, tapping a rich cheese-making and poultry-raising district.

WEBSTER CITY, IOWA—Plans are being made for an electric road between this city and Fort Dodge. It is proposed to take over the Crooked Creek road with the view of electrifying it. Business men of this city have met the officials of the Fort Dodge, Des Moines & Southern Interurban and discussed the feasibility of the plan.

FARIBAULT, MINN.—The city council has granted a franchise to the Dan Patch Air Line. One of the features of the franchise is that it will require the road to build a branch line northwest to Shieldsville, opening up a territory not reached by any railroad for many miles; also, connecting with French, Roberts and Shieldsville lakes.

WINDSOR, ILL.—The members of the city council have passed an ordinance granting a franchise to the Mattoon, Shelbyville, Pana & Hillsboro Company. The old ordinance was outlawed on account of the company not accepting the same until the time limit had expired. A franchise has also been granted the company by Shelbyville.

JOHNSTOWN, PA.—It has been officially announced that work will start within a few weeks upon the extensive line improvements planned by the Johnstown Passenger Railway Company. The Morrellville extension is to be constructed along the lines originally laid out, tracks are to be renewed along the valley pike, and minor improvements made on the Dale line.

REDLANDS, CAL.—Electricity, instead of gasolene, will be the motive power for the Redlands-Yucaipa Railway, which is now building to the Yucaipa Valley. The statement is made that the company will install two substations, one of which will be in the Yucaipa Valley. The road, when completed, will tap one of the richest agricultural sections in this section.

BOONE, IOWA—Announcement has been made by Joseph W. Gillis, representative of the Iowa Railroad, incorporated to build an interurban line from Waterloo, through Boone to Perry, to the effect that a branch of the road will be built from Ames to Des Moines. President Loring, of the Fort Dodge & Des Moines interurban, agrees to give the new interurban rights for the time being over his line into Des Moines.

COLUMBIA, MO.—A proposition has been made to the city of Columbia by the Mexico, Santa Fé & Perry Traction Company to extend the electric line from Macon to Columbia. The project, as outlined by the promoters, involves a spur to Jefferson City and South to Springfield. The line would also run northeast from Perry to Hannibal. Grading is under way on the line between Mexico and Perry and steel will be laid by August 1.

SPRINGFIELD, MO.—J. B. Quigley, civil engineer, of Sedalia, states that the electric road projected from Mansfield to Ava, the county seat of Douglas County, will be built this year. The name of the new road will be the Kansas City, Ozarks & Southern. The preliminary surveys for the road were made December 29, 1907. The city of Ava has raised a $30,000 bonus for the road, and main offices and repair shops will be located there.

BIRMINGHAM, ALA.—The Birmingham-Gulf Railway and Navigation Company, the concern that will build an electric railway from Gadsden, Ala., to Tuscaloosa, Ala., and then operate a barge line to Mobile and New Orleans, has filed a notice in the probate office of a meeting at which the capital stock was increased from $3,000 to $10,000,000. Work will be started on the electric railway before the expiration of this year and will be completed within two years.

ALBIA, IOWA—A contract has been secured for a sixty-mile extension of the seventeen-mile road which the Engineering Construction and Securities Company, of Chicago, Ill., built from Atlantic to Kimballton, Iowa, last year. The extension runs forty miles south from Atlantic and twenty miles north from Kimballton. The contract has been secured by C. A. Ross, vice-president of the Engineering Construction and Securities Company; C. B. Judd and H. S. Rattenborg.

TACOMA, WASH.—Henry Hewitt, Jr., has begun the construction of an electric railroad in the Coos Bay region in Oregon. Associated with Mr. Hewitt are Seymour Bell, who will be manager of the road, and L. V. Simpson, manager of the Simpson Lumber Company, and mayor of North Bend. The road will connect Marshfield and North Bend. Mr. Hewitt and Mr. Bell own the electric light and power plant on Coos Bay and have just completed the installation of a gas plant.

BENTON HARBOR, MICH.—Charles A. Applegate, a Chicago contractor, announces that he has obtained a contract for building the Chicago, Benton Harbor & Grand Rapids electric railroad. He says the line will start in Saugatuck, where connections will be made with the Holland & Grand Rapids interurban, which will go along the lake shore to South Haven, thence to Paw Paw Lake and Benton Harbor. Present plans include the extension of the line from here to Michigan City, making a through Benton Harbor-Chicago line.

MONTREAL, QUEBEC—The city council has passed twenty-eight clauses of the new by-law permitting the Southern Counties Railway Company to enter the city. The desire of the company is to operate an electric line on the south shore of the river. In order to reach the city the company will cross the Grand Trunk bridge. The company's contention is that a large passenger and freight business can be done by tapping the south shore with an electric line. In addition to passengers, freight will be brought into the city.

GREENVILLE, PA.—The council has voted to extend the time for the acceptance of the trolley franchise by the Mercer Construction Company until February 10, 1909, on which date the state

charter held by the Glatzan syndicate expires. The company was required to give a $1,000 bond to be forfeited in the event of failure to accept the franchise. Immediately on the granting of a state charter the company will be required to put up a $5,000 bond, guaranteeing the construction of the line. The proposed line will run from Greenville to Sharon and Mercer.

MASON CITY, IOWA—Articles of incorporation have been filed by the Mason City & Clear Lake Traction Company for the purpose of changing the name of the company to that of the Mason City & Clear Lake Railway Company and making the capital stock $200,000. The articles read that the object of the company shall be to build lines in Iowa and Minnesota. While the officers of the company will give out no definite information, it is understood that the filing of the articles is for the purpose of paving the way to an extension of the line in the near future.

MADISON, WIS.—The attorney-general has approved the articles of incorporation of the Oshkosh, Winneconne & Waupaca Railroad Company, of Oshkosh, which intends to build a road from Oshkosh to Waupaca, through Oshkosh, Vinland and Winneconne, in Winnebago County, Poysippi and Bloomfield, in Waushara County, and Fremont, Weyauwega and Lind, in Waupaca County, a distance of fifty miles. The company has a capital of $100,000. There are five incorporators: William M. Bray, E. H. Steiger, Elmer Leach, Edward W. Murphy and L. J. Monahan, all of Oshkosh.

PATERSON, N. J.—Arrangements are said to be under way for the incorporation of the North Jersey Transit Company, a corporation which intends to operate a trolley between this city and Suffern. The capital stock of the company will be $1,000,000, nearly all of which has been subscribed. The plans propose that the new road shall join the Hudson River line and extend through Glenrock, Ferndale, Ridgewood, Undercliffs, Allendale, Ramsey and on to Suffern. The road will be fifteen miles in length and it is estimated that the construction will cost $40,000 a mile. There are also plans under way for the construction of a trolley line from this city to New Foundland, running through Haledon, Pompton, Bloomingdale, Butler and Charlottsburg.

PORTLAND, ORE.—Budgets aggregating almost $1,500,000 for improvements and extensions to Portland trolley lines, both city and interurban, and city lighting and power systems, have been authorized by the directors of the Portland Railway, Light and Power Company, and the Oregon Electric Railway Company. President B. S. Josselyn, of the Portland Railway, Light and Power Company, has returned from the East with authority to expend $1,199,500 during the current year in betterments. President George Barclay Moffatt and other directors of the Oregon Electric Railway have instructed General Manager G. W. Talbot that he may expend $300,000 during the summer in substantial improvements to the Portland-Salem line and for new rolling stock.

NEW MANUFACTURING COMPANIES.

SALEM, ORE.—The Electrical Construction and Supply Company has been incorporated with a capital of $30,000. The incorporators are: Garfield B. Jolley, Leo L. Goodman and H. C. Browne.

OLNEY, ILL.—The American Lock-Out Telephone Company has been incorporated to manufacture telephones and supplies, with a capital of $5,000. The incoporators are: Guy E. Terhune, W. R. Huston and Alfred H. Pope.

ALBANY, N. Y.—The Stave Electrical Company, of New York city, has been incorporated with a capital of $100,000 by T. Stave, A. Watson and R. H. Smith, New York city, to manufacture steam turbines, engines, boilers, etc.

ALBANY, N. Y.—The Miniature Telephone Booth Company has been incorporated with a capital of $100,000 to manufacture telephone apparatus. The incorporators are: E. F. Hutton, G. A. Ellis, Jr.; W. F. S. Hart, New York city.

ALBANY, N. Y.—The Thomas Brace Rail Company, of New York city, has been incorporated with a capital of $2,000,000 to manufacture railroad rails and appliances, motors, cars, car wheels, structural iron or steel or metal castings. The directors are: Eddy T. Thomas and John Ochler, of New York; W. A. Campbell, T. H. Ross and C. B. Schellenburg, of Brooklyn.

TELEPHONE AND TELEGRAPH.

PROVIDENCE, R. I.—The Providence Telephone Company will ask stockholders in September for authority to increase the capital from $2,500,000 to $3,000,000. The company has declared a quarterly dividend of $1, payable July 1.

BIRMINGHAM, ALA.—The People's Home Telephone Company will start work shortly on extensive improvements to its system. The company plans to cover much new territory. F. G. McConnell is vice-president and general manager.

WENATCHEE, WASH.—A franchise has been granted A. L. McMullen to erect, maintain and operate a telephone line along the Stemilt Hill road, giving ranchers living in the south end of the county telephone communication with Wenatchee. Work will commence immediately.

LUDDINGTON, MICH.—Improvements that will entail an outlay of nearly $50,000 have been started on the lines of the Michigan State Telephone Company in Mason County. Reconstruction of the entire system and extension of lines to the resorts at Hamlin Lake are among alterations just begun.

CHRISTIANSBURG, VA.—A new franchise has been granted to the Virginia-Tennessee Telephone Company by the town council. The system will cost $12,000. The cost of service will be increased from $10 for private telephones to $12 and $15, and from $12 for office telephones to $18 and $20. The new system will be completed by October.

FREDERICKSBURG, VA.—At the annual meeting of the stockholders of the Upper Rappahannock Telephone and Telegraph Company the following officers were elected: Robert Beverley, president; E. J. Smith, Harry L. Baylor and A. F. Turner, vice-presidents; C. B. Conway, secretary; Dr. C. U. Gracatt, treasurer. A dividend of four per cent on the stock of the company was declared.

FLINT, MICH.—The Genesee Telephone Company, a new independent concern composed of local capitalists, has filed a trust mortgage for $250,000, to secure an equal bond issue. Fifty-one per cent of the stock has been placed in the hands of a Detroit trustee, as a guarantee that the plant will not be sold for ten years. James Martin, of Detroit, who promoted the company, has secured 4,000 contracts.

TOWANDA, KAN.—A number of farmers of Towanda and Augusta are planning the organization of the Augusta & Towanda Mutual Company. The intention is to connect with other mutual and independent lines. Connection can be had with the Potwin line at this city and a line is already under consideration to connect with the Whitewater line at Benton. A committee has been appointed to sell stock.

DATES AHEAD.

Society for the Promotion of Engineering Education. Annual meeting, Detroit, Mich., June 22-27.

American Railway Master Mechanics' Association. Atlantic City, N. J., June 22-24.

American Society for Testing Materials. Atlantic City, N. J., June 23-27.

American Society of Mechanical Engineers. Semiannual meeting, Detroit, Mich., June 23-26.

American Society of Civil Engineers. Annual meeting, Denver, Col., June 23-26.

Association of Railway Telegraph Superintendents. Annual meeting, Montreal, Quebec, June 24-26.

American Institute of Electrical Engineers. Annual convention, Atlantic City, N. J., June 29-July 2.

Street Railway Association of the State of New York. Annual meeting, Niagara Falls, N. Y., June 30-July 1.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15-17.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

INDUSTRIAL ITEMS.

THE F. BISSELL COMPANY, Toledo, Ohio, has issued another of its interesting souvenir postal cards playing upon the trade-mark, the "Bissell Frog," in making business engagements for its traveling representatives.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, keeps up its good work with its little magazine, "Common Sense." This small monthly is making a great hit all through the field, and it is worthy of all the attention that is being paid to it. In addition to the very interesting reading matter there is some modest advertising which is worthy of perusal.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has recently secured an order for 180,000 "Columbia" incandescent lamps, to be delivered at the rate of 15,000 per month, for Seattle, Wash. This is one of several large orders recently secured, and is an indication of improving business conditions. The western business of the Central Electric Company is being looked after by Burton R. Stare, Seattle, and J. A. Savage, traveling representative.

THE M. W. DUNTON COMPANY, Providence, R. I., manufacturer of uncoated armature tapes and sleevings, also "Nokorode" soldering compound, reports a general improvement in the volume of business along this line. The company also states that the high quality of its soldering flux has won for it the business of many of the largest and best-known users in the country. Once having ordered "Nokorode" customers rarely leave it for other products.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has recently issued a wall circular descriptive of the various types of "Sunbeam" lamps which it distributes. This wall circular will be found very useful by dealers, contractors and to central stations if hung up for reference. The circular is very comprehensive, covering all the standard types of "Sunbeam" lamps on the market, such as battery, miniature, candelabra, round-bulb, tubular, reflector, stereopticon, train-lighting, street series, Gem, tantalum, tungsten, etc. A copy will be sent to any one desiring it upon request to the Western Electric Company, Chicago, New York or any of the company's branch houses.

THE HOLOPHANE COMPANY, 227-229 Fulton street, New York city, has ready for distribution new price sheets on Holophane globes and reflectors. The new price sheets take effect as of June 15, and all orders received after that date must be in accordance with these prices. The list has been altered to read "price per hundred" instead of "price per dozen," as heretofore. This will greatly facilitate the figuring of the price of each, as all that will now be necessary to find the list price of any single globe or reflector will be to point off two decimal points. There have been made a few advances in prices, but these are more than balanced, due to cheapening the cost of production of certain globes and reflectors.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., which has acquired the offices and works of the Hadaway Electric Heating and Engineering Company, announces that the latter company has been removed to the Westinghouse works at East Pittsburg. This change will permit the business to be carried on upon a much larger scale than formerly, and all the standard appliances for hatters, confectioners, printers and other manufacturers will be turned out in larger quantities. Special attention will be given to the manufacture of sad-irons, glue pots and similar appliances that have recently become so popular. A New York office will be maintained on the twenty-second floor of the City Investing Building, 165 Broadway.

THE ELECTRIC CABLE COMPANY, Bridgeport, Ct., whose plant was burned a short time ago, is nearing completion with its new works. The company manufactures rubber-covered wire, magnet wire, weatherproof annunciator wire, Voltax feeder cables, office wire, Voltax insulating compound and Voltax protective compound for steel and wood. The company has entirely remodeled its works and redesigned its machinery. In fitting up the new plant advantage has been taken of the opportunity of securing the most modern machines for turning out a perfect product at a low operating cost. Ideal office and shipping facilities are also secured, and the company will be in a splendid position for handling orders of any magnitude. Offices are maintained at 17 Battery Place, New York city; Monadnock Block, Chicago, Ill., and Old South Building, Boston, Mass.

Record of Electrical Patents.

Week of June 9.

889,891. METHOD OF PREPARING CARBON ARTICLES. Peter M. Bennie, Niagara Falls, N. Y., assignor to National Carbon Company. Carbon is prepared for machining by softening locally through the action of an electric arc.

889,907. SYSTEM OF ELECTRIC-MOTOR CONTROL. William Cooper, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Means are provided for suspending the closing of the controlling switches, the former being actuated by the current traversing the motor.

889,908. REGENERATIVE SYSTEM OF CONTROL. William Cooper, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A method of grouping two motors so that one acts as an exciter to the other and at the same time the transformer connections are properly adjusted.

889,911. SYSTEM OF DISTRIBUTION FOR DIRECT CURRENT. Frederick Darlington, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Two machines, coupled together mechanically, are connected in series and means provided for varying the field excitation.

889,929. ELECTROLYTIC METER. George Hookham and Sydney H. Holden, Birmingham, England. A depolarizing electrode is employed, consisting of a metal capable of absorbing hydrogen.

889,931. ELECTRICAL TRANSFORMER. Svend E. Johannesen, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The two coils are divided into sections alternately disposed, one set being connected in series, and the other in parallel.

889,937. ELECTRODE FOR ARC LAMPS. George M. Little, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The electrode is formed of a rod of iron with embedded strips of copper.

889,956. INSULATOR. John P. Nikonow, Pittsburg, Pa. A suspension or strain insulator.

889,963. MERCURY SWITCH FOR RAILWAYS AND THE LIKE. Robert Pfeil, Grunewald, near Berlin, Germany, assignor to Siemens & Halske, A. G., Berlin, Germany. A diaphragm, depressed by the passage of a train, closing a signaling circuit.

889,989. TRANSFORMER REGULATOR. Wilbur H. Thompson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A transformer having a circular core with coils mounted so as to rock about the centre of the core.

890,001. ELECTRIC SAFETY AND ALARM SYSTEM FOR RAILROADS. Herbert D. Williams and Marcus Leonard, Vermillion, Kan.; said Leonard assignor to said Williams. An automatic system for controlling electromagnetically braked trains.

890,030. ELECTRIC RAILWAY BOND. John Dolan, Dayton, Ohio. A laminated bond with solidified terminals.

890,042. AUTOMATIC TELEGRAPHIC TRANSMISSION INSTRUMENT. John Gell, London, England. A sender operated by perforated tape.

890,053. ELECTRICAL INSTANTANEOUS WATER HEATER. Louis C. Henriksen, Los Angeles, Cal. Heating coils are interposed between the turns of the water pipe.

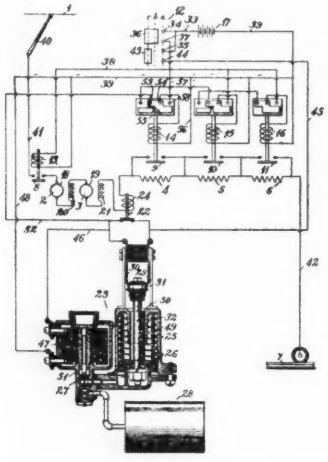
890,058. TROLLEY. Samuel D. Hunt, Youngstown, Ohio. A pair of auxiliary side wires is provided, which engage beneath supplementary trolley wheels on the main harp.

890,144. AUTOMATICALLY CONTROLLING ELECTRIC MOTORS. Harry W. Leonard, Bronxville, N. Y. The combination of a motor-generator group supplying power to a driving motor and means for controlling the excitation of the generator.

890,183. MAGNETIC CIRCUIT-BREAKER. Ralph Scott, New Brunswick, N. J., assignor to Scott Electrical Equipment Company. A circuit-breaker opened by a spring when released electromagnetically.

890,195. TELEGRAPHONE. Harve R. Stuart, Wheeling, W. Va. Means are provided for shifting the recording magnet radially over the recording disc.

890,197. SIGNAL SYSTEM FOR RAILWAYS. Louis H. Thullen, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An alternating-current signaling system.



889,907.—System of Electric Motor Control.

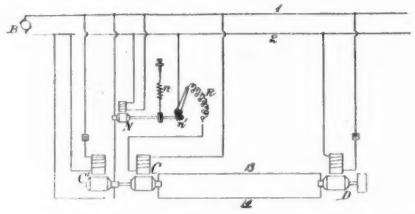
890,198. ELECTRIC RAILWAY. Louis H. Thullen, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An indicator is provided for showing the difference of potential between adjacent track sections.

890,200. ELECTRIC CUTOUT. William C. Tregoning, Cleveland, Ohio, assignor to the Tregoning Electric Manufacturing Company, Cleveland, Ohio. A form of construction of fixture cutouts.

889,937.—Electrode for Arc Lamps.

890,201. TROLLEY REPLACER. John Trout, Philadelphia, Pa. Arms are provided for guiding the wheel to the wire.

890,220. ELECTROMAGNETIC SIGNAL-CONTROLLING DEVICE. Henry M. Crane, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. A magnet with a double air-gap and two armatures, one acting when both gaps are open, and the second, only after one gap has been closed by the first armature.



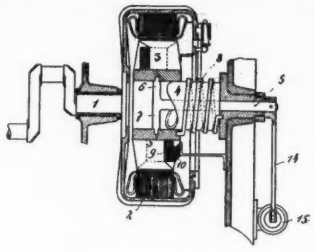
890,144.—Automatically Controlling Electric Motors.

890,246. ELECTRO-AUTOMATIC ADVERTISING MACHINE. Clarence Myers and Alonzo H. Burchard, Houston, Tex., assignors to Bruce Detrich, Kansas City, Kan. An electrically driven card-displaying device.

890,249. PROCESS OF OBTAINING PURE TIN FROM CRUDE TIN OR TIN ALLOY ELECTROLYTICALLY. Otto Steiner, Crefeld, Germany. Crude tin is dissolved in a solution of an alkali sulphide and electrolyzed.

890,255. INCLOSED FUSE. Frederick H. Weston, Jr., and Frank C. De Reamer, Schenectady, N. Y., assignors to General Electric Company. The end caps of the case are provided with contact members extending through them.

890,285. CONDUIT COVER. Hubert Krantz, New York, N. Y. The cover is held in place by means of screws and clamping bars.

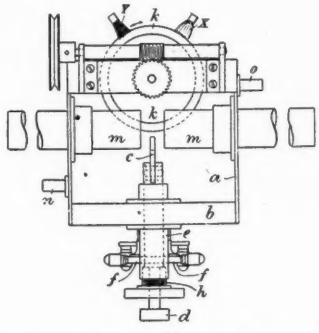


890,299.—Automatic Regulation for Dynamoelectric Machines.

890,299. AUTOMATIC REGULATION FOR DYNAMOELECTRIC MACHINES. Ferdinand Porsche, Vienna, Austria-Hungary. A dynamo to be driven by an internal-combustion engine constructed so that the magnetic flux automatically varies inversely as the torque exerted on the field magnet.

890,349. ALARM-SIGNAL MECHANISM. Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill., assignors to Zorge Safety Railway Equipment Company. An electromagnetic system for placing track torpedoes.

890,403. TIME-CONTROLLED ELECTRIC SWITCH. Richard B. Brauer, Richmond, Va. A time-switch controlled by the joint action of two alarm clocks.

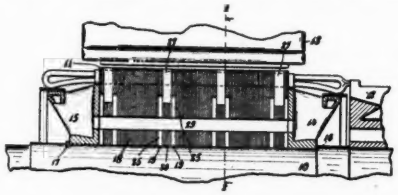


890,451.—Generator of Electric Oscillations.

890,451. GENERATOR OF ELECTRIC OSCILLATIONS. Valdemar Poulsen, Copenhagen, Denmark. An arc is struck between two electrodes, one of which, the true electrode, has a thin coating which is continuously renewed.

890,458. SYSTEM OF MOTOR CONTROL. George B. Schley, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. A system employing a master controller which is disconnected by the removal of the handle.

890,496. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company. The motor-starter automatically shunts the main fuse to prevent blowing it when starting the machine.



890,577.—Ventilated Laminated Core for Dynamoelectric Machines.

890,539. FIELD-COIL SUPPORT. Emmett W. Stull, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. A plate of spring metal with bent tabs which provide a yielding support.

890,577. VENTILATED LAMINATED CORE FOR DYNAMOELECTRIC MACHINES. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. The laminæ of the core are provided with openings and assembled so that these overlap, leaving ventilating passages.